Air Quality Monitoring

Whitecourt and Swan Hills Area

Alberta Environment

November 2000 to June 2001 — Final Report

Summary

Alberta Environment conducted an air quality monitoring survey in the Whitecourt and Swan Hills area from November 2000 to June 2001. The survey was conducted in consideration of requests from local municipal officials and some members of the general public. Communities monitored during the survey included Whitecourt, Swan Hills, Kinuso, Fort Assiniboine and Shiningbank Lake area. Monitoring was also conducted near industries in the Whitecourt area. The overall purpose of the survey was to ensure understanding of air quality within and near these communities. Specific objectives of the survey were to: (1) measure air pollutant levels in the region; (2) compare air quality levels with Alberta's Ambient Air Quality Guidelines; and (3) compare air quality levels to other locations in Alberta and with previous air quality surveys conducted in the Swan Hills area. The monitoring survey consisted of two components.

(1) The Alberta Environment *Mobile Air Monitoring Laboratory* (MAML) was used to monitor air quality at 13 sites in the Whitecourt, Swan Hills, Kinuso, Fort Assiniboine and Shiningbank Lake areas. This unit monitored for air pollutants including sulphur dioxide, particulates, oxides of nitrogen, ozone, hydrocarbons, carbon monoxide, hydrogen sulphide and ammonia using continuous analyzers. A total of 136 hours of data were collected on 20 days from November 2000 to June 2001 by the MAML.

(2) Stationary samplers were set up to monitor for chemicals that are potentially emitted by the Swan Hills Treatment Centre (SHTC) in the communities of Swan Hills, Kinuso and Fort Assiniboine and also near the SHTC. A total of 20 samples were analyzed for dioxins, furans and PCBs from November 2000 to February 2001.

Results and Conclusions

Ambient levels of all air pollutants measured by the MAML were below Alberta's Ambient Air Quality Guidelines. Alberta has one-hour air quality guidelines for sulphur dioxide, nitrogen dioxide, ozone, carbon monoxide, hydrogen sulphide and ammonia. These guidelines are some of the most stringent in North America. Maximum one-hour concentrations were:

- 26% of the one-hour guideline for sulphur dioxide,
- 14% of the one-hour guideline for nitrogen dioxide,
- 66% of the one-hour guideline for ozone,

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- 5% of the one-hour guideline for carbon monoxide,
- 30% of the one-hour guideline for hydrogen sulphide, and
- 1% of the one-hour guideline for ammonia.

Sulphur dioxide and hydrogen sulphide concentrations were low at all monitoring locations in the survey area. The major sources of these pollutants in the Whitecourt and Swan Hills area are processes associated with the sour gas industry. The highest concentrations of both of these air pollutants were measured downwind of the Windfall gas plant located about 30 km west of Whitecourt. The maximum one-hour sulphur dioxide concentration was 0.046 ppm (parts per million) compared to the one-hour guideline of 0.172 ppm. The maximum one-hour hydrogen sulphide concentration was 0.003 ppm compared to the guideline of 0.010 ppm.

Elevated levels of large particles were measured at several sites in Whitecourt/Swan Hills survey area. The highest total suspended particulate (TSP) and inhalable particulate (PM_{10}) concentrations were measured in the northwest industrial sector of Whitecourt. Maximum one-hour TSP and PM_{10} concentrations at this location were 946 and 441 $\mu g/m^3$ (micrograms of particulate per cubic metre of air), respectively. Elevated levels of large particulate in Whitecourt were likely due to local industry. Elevated levels of large particulates at other monitoring sites in the survey area were caused by local traffic on gravel roads. Alberta does not have a one-hour guideline for TSP or PM_{10}, however the 24-hour TSP guideline in Alberta is 100 $\mu g/m^3$.

Concentrations of small, respirable particulates ($PM_{2.5}$) were similar to other rural and small urban locations in Alberta. The maximum one-hour concentration measured during the survey was 43 $\mu g/m^3$ recorded in the Shiningbank Lake area. This maximum value was associated with road dust caused by local traffic near the monitoring sites. $PM_{2.5}$ refers to particles that are small enough to be deposited into the lungs and, depending on their composition, may be a health concern. Alberta does not have a one-hour guideline for $PM_{2.5}$, although the 24-hour Canada-wide Standard benchmark concentration for $PM_{2.5}$ is 30 $\mu g/m^3$.

Toxic equivalent (TEQ) concentrations of dioxins and furans in the 2000/01 Swan Hills survey were lower than levels measured during the 1997/98 Swan Hills survey and other locations in Alberta. The average and maximum TEQ values measured in the 2000/01 survey were 0.007 and 0.032 pg/m^3 (picograms per cubic metre of air), respectively. The average and maximum TEQ concentrations from the 1997/98 survey were 0.013 and 0.117 pg/m^3, respectively. Higher dioxin and furan levels in the 1997/98 surveys were likely influenced by the explosion at the SHTC that occurred in July 1997 and forest fires in the Swan Hills area that occurred in May 1998. Average TEQ levels for dioxins and furans in the Swan Hills survey were much lower than the average concentration based on 13 samples collected at other locations in Alberta (0.102 pg/m^3).

PCB levels were also low in the 2000/01 Swan Hills area survey. The maximum total PCB concentration measured in the 2000/01 survey was 0.046 ng/m^3 (nanograms per cubic metre) compared to a maximum concentration of 163 ng/m^3 in the 1997/98 Swan Hills area survey. Alberta does not have a guideline for PCBs however, the 24-hour Ambient Air Quality Criteria in Ontario is 150 ng/m^3.

Part 1: Monitoring Using the Mobile Air Monitoring Laboratory

Alberta Environment monitored air quality using the *Mobile Air Monitoring Laboratory* (MAML) in the Whitecourt and Swan Hills areas from November 2000 and June 2001. The survey included the area in and around the communities of Whitecourt, Swan Hills, Kinuso, Fort Assiniboine and Shiningbank Lake. Air quality was monitored on the following dates representing the winter, spring, summer and fall seasons.

- Fall (November 20 to 24, 2000).
- Winter (February 20 to 22 and March 1 and 2, 2001).
- Spring (May 7 to 11, 2001).
- Summer (June 25 to 29, 2001).

A total of 136 hours of data was collected at 13 sites. Data was collected for:

- 93 hours in the Whitecourt area (four sites in the town of Whitecourt and four sites northwest of town),
- 24 hours in the Swan Hills area (one site in Swan Hills, two sites in the Fort Assiniboine area and one site in Kinuso), and
- 19 hours in the Shiningbank Lake area.

The monitoring sites were selected based on public concern, consultation with regional staff from Alberta Environment and observations by the MAML operators. Monitoring was conducted for a minimum of one hour at each location to allow comparison with Alberta's Ambient Air Quality Guidelines. The MAML monitoring sites are indicated in Figures 1.1, 1.2, and Table 1.1 (pages four and five).

The Mobile Air Monitoring Laboratory

The MAML is a 27-foot (8.2 m) vehicle that has been specially designed and equipped to measure air quality. It houses a variety of instruments that continuously sample the air at specified time or distance intervals. The MAML is equipped with:

- A dual computer system custom-programmed to accept and record the measurement of air samples from each analyzer.
- A GPS (Global Positioning System) that identifies the MAML's location as it moves around Alberta.
- An exhaust purifying system that minimizes emissions from the vehicle.
- Two on-board generators that are also equipped with exhaust scrubbers.

The parameters measured by the MAML during the Whitecourt/Swan Hills area survey are indicated in Table 1.2 (page six). Tables A1 to A4 in the Appendix (pages 29 to 31), contain median and maximum air parameter concentrations at all sites during the survey and typical median and maximum air pollutant levels at other locations in Alberta. Air quality parameter concentrations, weather conditions and the MAML operator's comments for each location monitored are indicated in Tables A5 to A12 in the Appendix (pages 32 to 39).

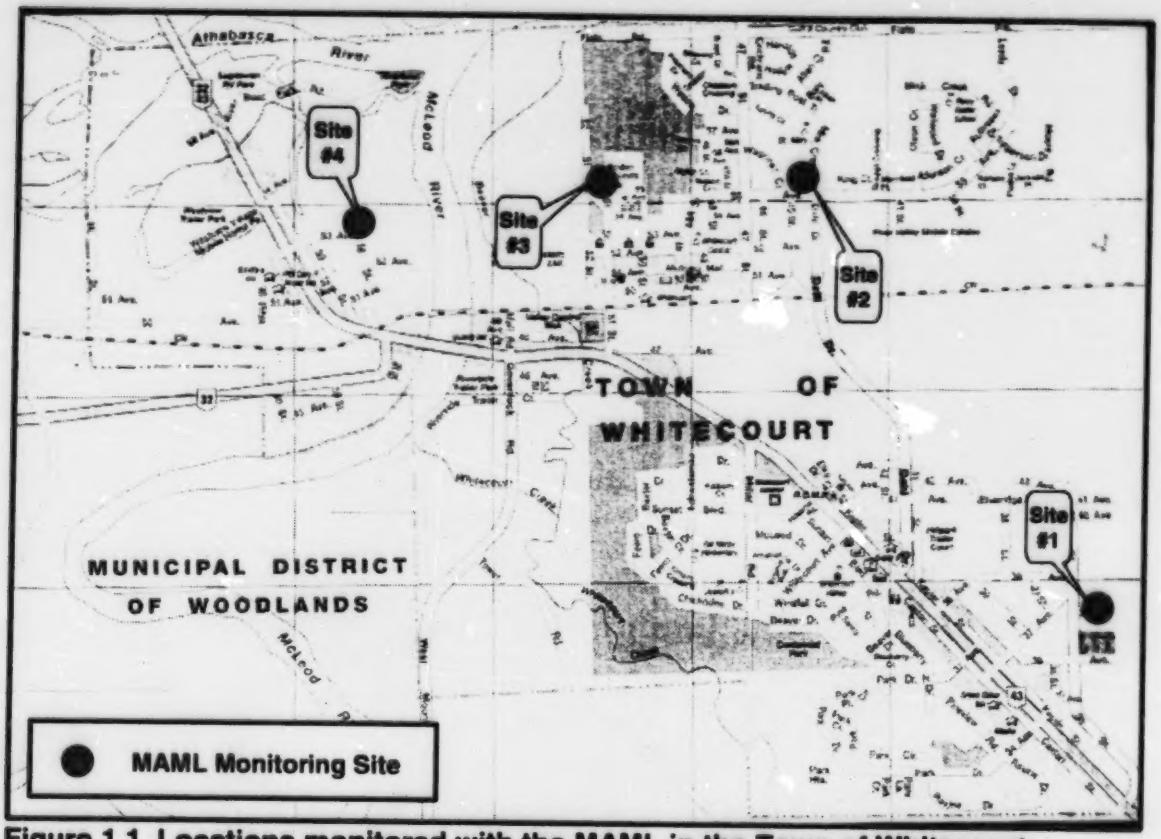

Figure 1.1 Locations monitored with the MAML in the Town of Whitecourt.

Area	Site #	Monitoring Location		Dates Monitored				
				Nov, 2000	Feb, 2001	Mar, 2001	May, 2001	June, 2001
Whitecourt	1	SE Industrial area	37 Ave.& 35 St.	21, 23		1, 2	8, 10	27, 28
	2	NE Residential Area	55 Ave.& Dahl Dr.	21, 23		1, 2	8, 10	27, 28
	3	Town Center	51 St.& 55 Ave.	21, 23			10	
			52 St.& 52 Ave			1, 2	8	27, 28
	4	NW Industrial Area	53 Ave.& 58 St.	21, 23		1, 2	8, 10	27, 28
	5	Petro Canada Gas Plant (Sold to Shiningbank Energy)	12-26-59-11W5	21, 23	20, 22		7, 11	25, 26
	6	Amoco Windfall Gas Plant (now Central Alberta Midstream)	S1/2-17-60-15 W5	20, 24	20, 22			26
	7	Whitecourt Power Generating Station	SE 4-60-12 W5	20, 21, 24	22	1	8, 10	25, 27
	8	Alberta Newsprint (ANC)	SE 13-60-13 W5	24		1, 2	8, 10	26
Swan Hills	9	Fort Assiniboine Ranger Station.	Fort Assiniboine.	22	21		9	29
	10	Fort Assiniboine Rodeo Grounds.	Fort Assiniboine.	22	21		9	29
	11	Swan Hills Hospital.	Assiniboine Dr.& Freeman Dr.	22	21		9	29
	12	Kinuso School.	Village of Kinuso.	22	21		9	29
Shiningbank Lake	13	Shiningbank Lake	Area of Shiningbank Lake	20, 24	20, 22		7, 11	25

Table 1.1 List of site numbers and associated locations monitored by the MAML.

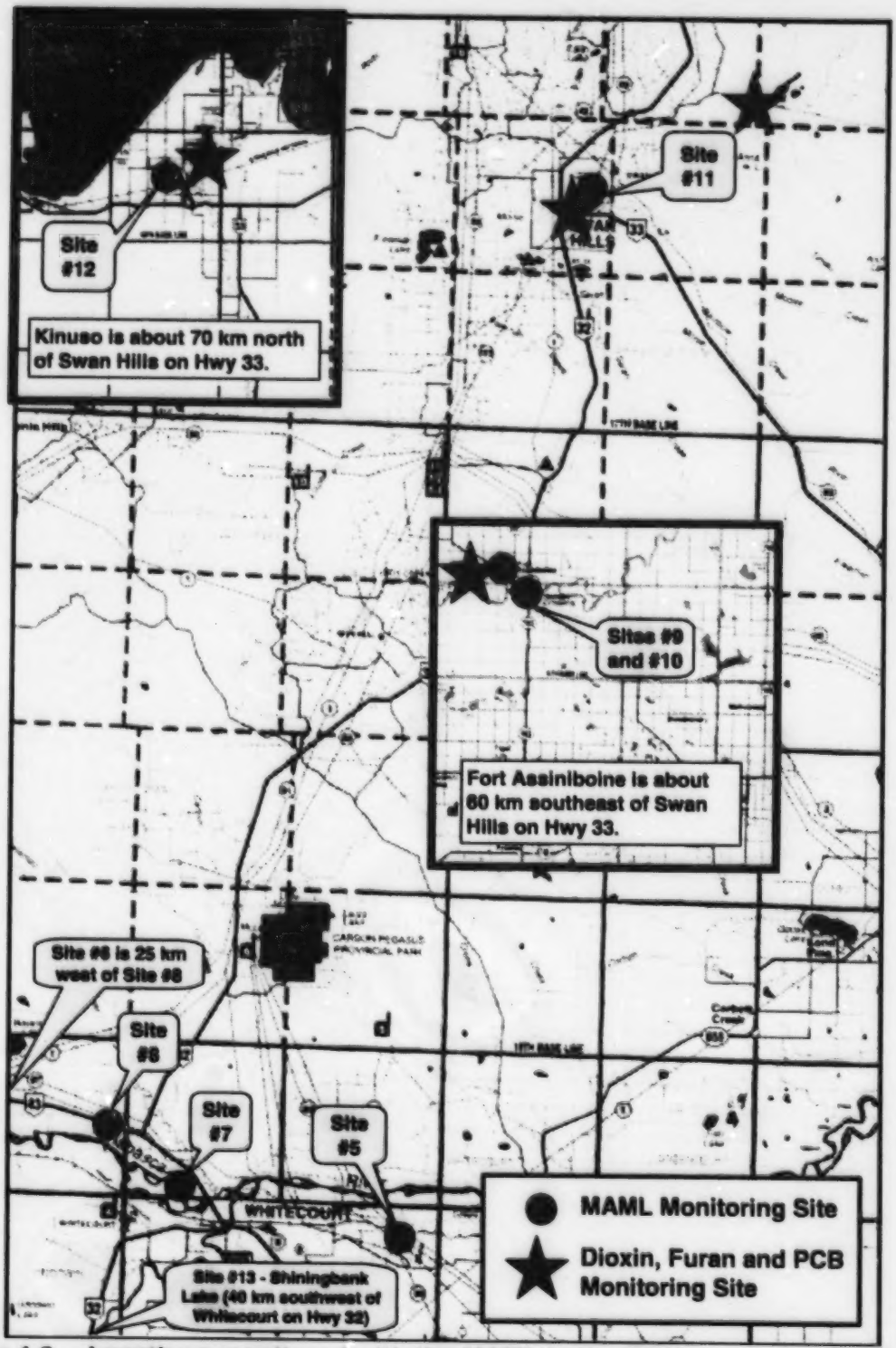
Site #12
Kinuso is about 70 km north of Swan Hills on Hwy 33.
Site #11
Sites #9 and #10
Fort Assiniboine is about 60 km southeast of Swan Hills on Hwy 33.
Site #6 is 25 km west of Site #8
Site #8
Site #7
Site #5
WHITECOURT
Site #13 - Shiningbank Lake (40 km southwest of Whitecourt on Hwy 32)
MAML Monitoring Site
Dioxin, Furan and PCB Monitoring Site

Figure 1.2 Locations monitored with the MAML in the Whitecourt, Swan Hills and Shiningbank Lake areas.

Figure 1.3 Alberta Environment's Mobile Air Monitoring Laboratory (MAML).

Table 1.2 Parameters monitored by the MAML (also includes minimum detection limits and operating ranges).

Parameter Measured	Minimum Detectable Limit*	Operating Range**
sulphur dioxide (SO_2)	0.6 ppb	1 ppm
hydrogen sulphide (H_2S)	0.6 ppb	1 ppm
total reduced sulphur (TRS)	0.6 ppb	1 ppm
total hydrocarbons (THC)	0.005 ppm	20 ppm
reactive hydrocarbons (RHC)	0.005 ppm	20 ppm
methane (CH_4)	0.005 ppm	10 ppm
polycyclic aromatic hydrocarbons (PAHs)	3 ng/m^3	1000 ng/m^3
ozone (O_3)	0.001 ppm	0.5 ppm
nitrogen dioxide (NO_2)	1.0 ppb	1 ppm
nitric oxide (NO)	1.0 ppb	1 ppm
total oxides of nitrogen (NO_x)	1.0 ppb	1 ppm
total suspended particulates (TSP)	1 $\mu g/m^3$	1.0 g/m^3
inhalable particulates (PM_{10})	1 $\mu g/m^3$	1.0 g/m^3
respirable particulates ($PM_{2.5}$)	1 $\mu g/m^3$	1.0 g/m^3
carbon monoxide (CO)	0.1 ppm	50 ppm
ammonia (NH_3)	1.0 ppb	5 ppm
wind direction (WDR)	0 degrees	360 degrees
wind speed (WSP)	0 kph	200 kph
temperature (Temp)	-40 °C	50 °C
relative humidity (RH)	0 %	100 %

ppb = parts per billion
ppm = parts per million
ng/m^3 = nanograms per cubic metre
$\mu g/m^3$ = micrograms per cubic metre
g/m^3 = grams per cubic metre
kph = kilometres per hour
°C = degrees Celsius
% = per cent

* The ***minimum detectable limit*** indicates the *minimum* amount of pollutant the instrument can measure.

** The ***operating range*** indicates the *maximum* amount of pollutant the instrument can detect. This limit is set to provide the optimum precision over that range. The upper limit can be raised, however, precision at the lower levels (where most levels are monitored) is then compromised.

Alberta's Ambient Air Quality Guidelines

Alberta's Ambient Air Quality Guidelines[1] are established under Section 14 of the Environmental Protection and Enhancement Act (EPEA). EPEA provides for the development of guidelines and ambient environmental quality objectives for all or part of Alberta.

The Ambient Air Quality Guidelines are used for:

- reporting on the state of the atmospheric environment in Alberta.
- reporting to Albertans on the quality of air through an air quality index.
- establishing approval conditions for regulated industrial facilities.
- evaluating proposals to construct facilities that will have air emissions.
- guiding special ambient air quality surveys.
- assessing compliance near major industrial air emission sources.

Alberta's Ambient Air Quality Guidelines for one-hour concentrations of parameters monitored by the MAML are indicated in Table 1.3.

[1] *Alberta Ambient Air Quality Guidelines.* Alberta Environment. February 2000.

Table 1.3 Alberta's Ambient Air Quality Guidelines for parameters measured by the MAML.

Air Quality Parameter	One-hour Guideline (ppm*)	Basis for Guideline
hydrogen sulphide	0.01	odour perception
ammonia	2	odour perception
carbon monoxide	13	oxygen carrying capacity of blood
nitrogen dioxide	0.212	odour perception
ozone	0.082	reduction of lung function and effects on tomatoes
sulphur dioxide	0.172	taste, odour perception and effects on bluegrass

* Parts per million by volume.

Sulphur Dioxide (SO_2)

maximum one-hour concentration recorded during survey	one-hour guideline
0.046 ppm	0.172 ppm (based on taste, odour perception and effects on bluegrass)

Sulphur dioxide (SO_2) is a colourless gas with a pungent odour. In Alberta, it is estimated that 45 per cent of SO_2 emissions are produced by natural gas processing plants while oil sands and power plants produce about 26 per cent and 21 per cent of SO_2 emissions, respectively[2]. Other sources include gas plant flares, oil refineries, pulp and paper mills and fertilizer plants.

SO_2 levels were below Alberta's one-hour guideline at all sites monitored in the survey area. The maximum one-hour concentration of 0.046 ppm was measured at Site #6 (Windfall gas plant) on November 24, 2000. This reading is about one-quarter of the one-hour guideline and was likely caused by emissions from the nearby plant. The second and third highest SO_2 concentrations were also measured at Site #6 (0.045 ppm on February 22, 2001 and 0.025 ppm on June 26, 2001). SO_2 levels in the Shiningbank Lake, Kinuso, Fort Assiniboine and Swan Hills areas were very low with maximum values of 0.003 ppm or less.

SO_2 concentrations measured in the Whitecourt/Swan Hills area survey were similar to those measured during other MAML surveys in the province. The maximum one-hour levels measured in the County of Grande Prairie, Caroline/Sundre and Bow Corridor surveys ranged from 0.043 to 0.092 ppm compared to 0.046 ppm in the Whitecourt/Swan Hills survey. Maximum one-hour SO_2 concentrations at permanent monitoring stations in Alberta ranged from 0.006 ppm (in west-central Alberta) to 0.231 ppm north of Fort McMurray in 2001. Data for other locations are shown in Tables A3 and A4 (pages 30 and 31) in the Appendix to this report.

[2] *Environment Canada. 1998. 1995 Criteria Air Contaminant Emissions Inventory Summaries. Pollution Data Branch, Environment Canada.*

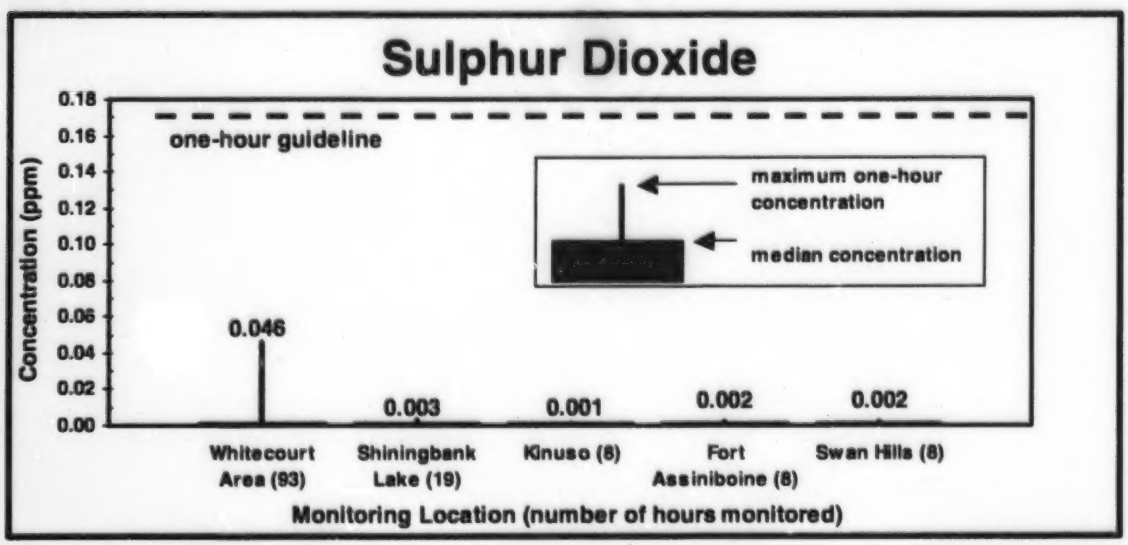

Figure 1.4 One-hour median and maximum concentrations for sulphur dioxide.

Hydrogen Sulphide and Total Reduced Sulphur (H_2S and TRS)

maximum one-hour concentration recorded during survey	one-hour guideline
H_2S = 0.003 ppm	0.010 ppm (based on odour perception)
TRS = 0.005 ppm	no guideline

Hydrogen sulphide (H_2S) is a colourless gas with a rotten egg odour. Total reduced sulphur (TRS) includes hydrogen sulphide, mercaptans, dimethyl sulphide, dimethyl disulphide and other sulphur compounds. Sulphur dioxide is not included in the determination of TRS. Industrial sources of H_2S and TRS include fugitive emissions (leakages) from petroleum refineries, tank farms for unrefined petroleum products, natural gas plants, petrochemical plants, oil sands plants, sewage treatment facilities, pulp and paper plants that use the Kraft pulping process, and animal feedlots. Natural sources of H_2S include sulphur hot springs, sloughs, swamps and lakes.

H_2S concentrations were below Alberta's one-hour air quality guideline at all locations monitored during the survey. The maximum one-hour concentration of 0.003 ppm was measured at Site #6 (Windfall gas plant), from 9:17 a.m. to 10:17 a.m. on November 24, 2000. The highest one-hour TRS concentration of 0.005 ppm was also recorded at this time. Sulphur compounds at this location were likely due to fugitive emissions from the nearby gas plant. The maximum H_2S concentration measured at this location was 30 per cent of the one-hour guideline for H_2S. One-hour H_2S concentrations were 0.001 ppm or lower at the remaining monitoring locations.

Maximum one-hour H_2S concentrations measured during other MAML surveys in Alberta ranged from 0.002 ppm in the Bow Corridor to 0.054 ppm in the Lethbridge area. Based on 2001 data, maximum one-hour H_2S levels generally range from 0.005 ppm (Red Deer) to 0.038 ppm (Calgary East). H_2S levels are generally higher near sources such as sewage treatment plants and facilities that process sour gas. Data for other locations in Alberta are presented in Tables A3 and A4 in the Appendix (pages 30 and 31).

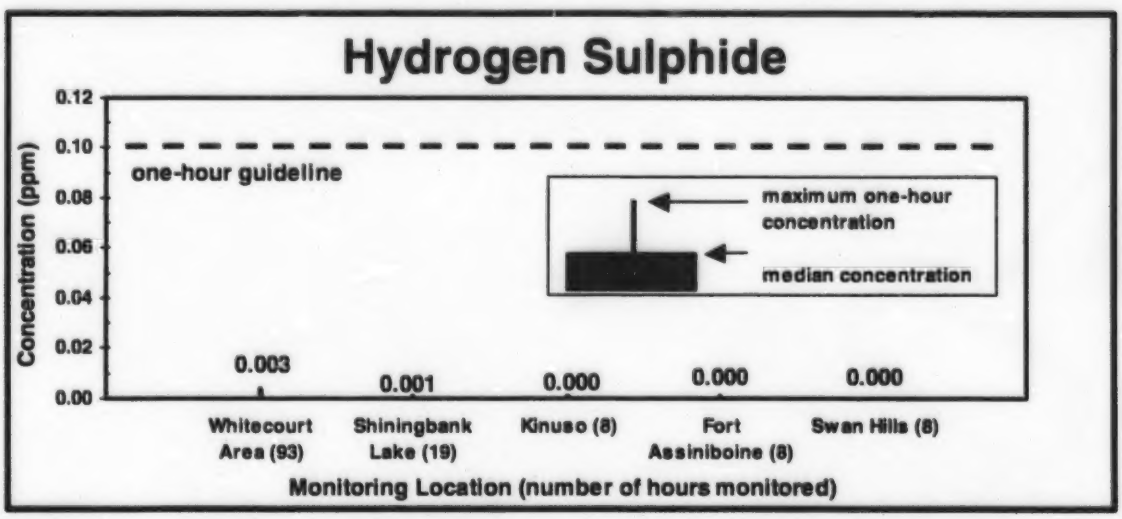

Figure 1.5 One-hour median and maximum concentrations for hydrogen sulphide.

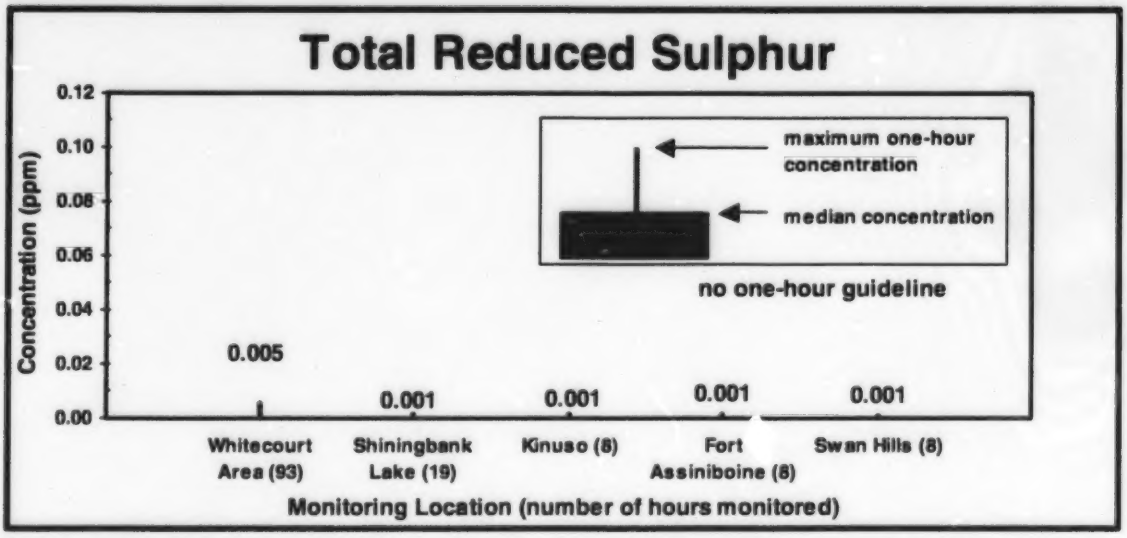

Figure 1.6 One-hour median and maximum concentrations for total reduced sulphur.

Hydrocarbons (THC, RHC and CH_4)

maximum one-hour concentration recorded during survey	one-hour guideline
THC = 4.3 ppm	no guideline
RHC = 2.5 ppm	no guideline
CH_4 = 2.5 ppm	no guideline

The term "total hydrocarbons" (THC) refers to a broad family of chemicals that contain carbon and hydrogen atoms. Methane (CH_4), a non-reactive hydrocarbon, is the most common hydrocarbon in the earth's atmosphere. Specific reactive hydrocarbons (RHC) are important because they can react with oxides of nitrogen in the presence of sunlight to form ozone, and they can be toxic (at high concentrations) to humans, animals or vegetation. Sources of hydrocarbons include vegetation, vehicle emissions, gasoline marketing and storage tanks, petroleum and chemical industries, dry cleaning, fireplaces, natural gas combustion and aircraft traffic. Hydrocarbons are also emitted by fugitive sources such as evaporation of solvents, or leaking valves, flanges, pumps and compressors at industrial facilities. Incinerator and flare stacks can also be sources of hydrocarbons. Many hydrocarbons, such as CH_4, are emitted by natural sources. Normal background THC concentrations recorded in rural Alberta range from 1.5 to 2.0 ppm. Background hydrocarbons are primarily composed of CH_4 with a small contribution from RHC (about 0.2 ppm).

Hydrocarbon levels measured during the Whitecourt/Swan Hills area survey were close to natural background levels at most locations. The highest hydrocarbon concentration was measured at Site #4 (northwest industrial area of Whitecourt) on November 21, 2000 from 7:22 p.m. to 8:22 p.m. The MAML operator noted odours when this reading was recorded. However, the source of these odours could not be determined.

Median THC levels ranged from 2.1 ppm in Swan Hills to 2.4 ppm in the Whitecourt area. Slightly higher hydrocarbon levels in

the Whitecourt area were caused by emissions from vehicles and nearby industries. Median THC levels at other Alberta locations ranged from 1.8 to 2.2 ppm (see Table A3, page 30).

The maximum THC concentration of 4.3 ppm was low compared to maximum levels measured at other locations in Alberta. Maximum THC levels from other MAML surveys that ranged from 2.2 ppm in Lethbridge to 32.4 ppm in the Grande Prairie area. Maximum one-hour THC levels ranged from 3.5 to 25.0 ppm at permanent monitoring stations in Alberta in 2001 (Table A4 on page 31).

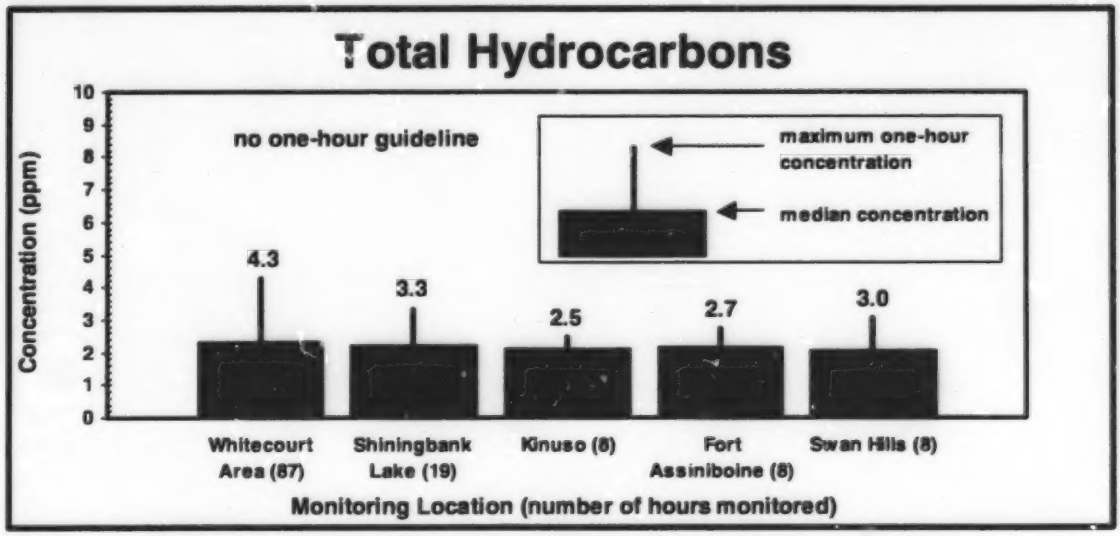

Figure 1.7 One-hour median and maximum concentrations for total hydrocarbons.

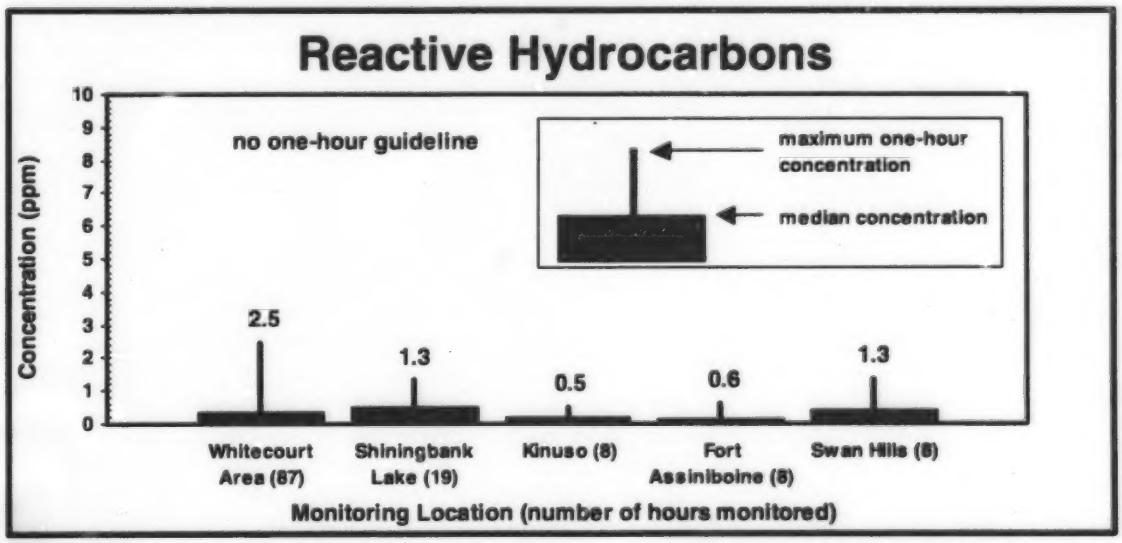

Figure 1.8 One-hour median and maximum concentrations for reactive hydrocarbons

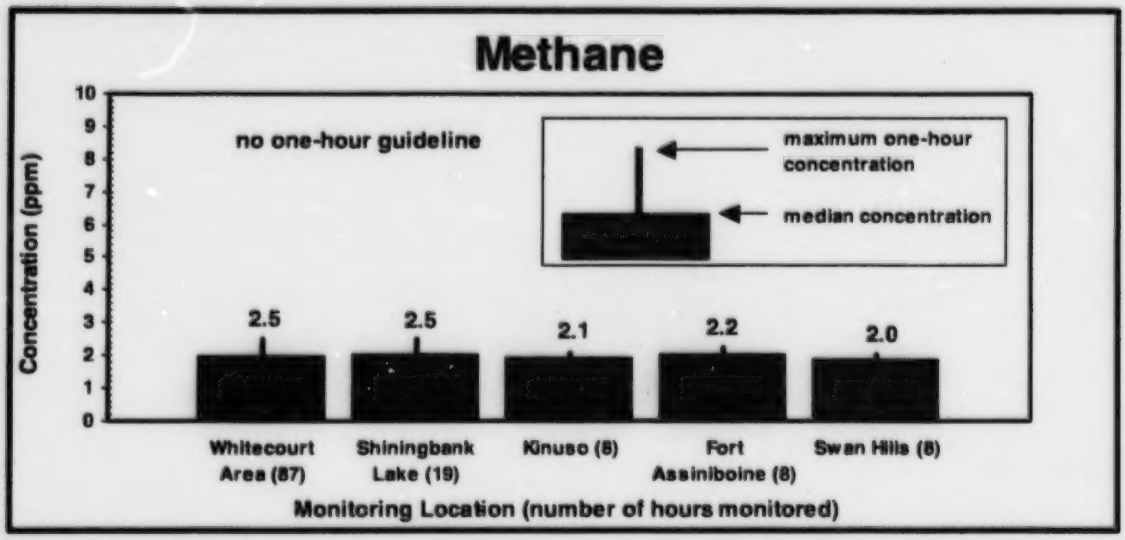

Figure 1.9 One-hour median and maximum concentrations for methane.

Particulates (TSP, PM_{10} and $PM_{2.5}$)

maximum one-hour concentration recorded during survey	one-hour guideline
TSP = 946 µg/m^3	no guideline
PM_{10} = 441 µg/m^3	no guideline
$PM_{2.5}$ = 43 µg/m^3	no guideline

Air pollutants are not necessarily in a gaseous form. Tiny particles of solid material or liquid droplets, defined collectively as particulates, are also present in the atmosphere. Total suspended particulates (TSP) refer to all particles up to 500 microns in diameter (a human hair is about 100 microns in diameter) and are important primarily from a nuisance perspective. Particles less than 10 micrometres in diameter (PM_{10}) can be inhaled into the nose and throat while smaller particles, less than 2.5 micrometres in diameter ($PM_{2.5}$), can penetrate into the lungs. Sources of particulates include soil dust, road dust, agricultural dust (e.g., harvest), smoke from forest fires and recreational wood burning, vehicle exhaust emissions, brake and tire wear, and industrial emissions. Smaller particles ($PM_{2.5}$) originate in the atmosphere because of condensation and combustion from sources such as vehicle exhaust emissions, industrial emissions and wood burning. $PM_{2.5}$ are also formed as a result of reactions of gaseous chemicals in the air.

High levels of large particulates were recorded at several sites during this survey. The highest one-hour TSP and PM_{10} concentrations were measured at Site #4 (industrial area of northwest Whitecourt) on November 21, 2000 (12:07 p.m. to 1:04 p.m.) with one-hour concentrations of 946 and 441 µg/m^3, respectively. The next highest TSP and PM_{10} levels were measured at Site #3 (downtown Whitecourt) on May 8, 2001 (10:26 a.m. to 11:26 a.m.) with TSP and PM_{10} concentrations of 696 and 338 µg/m^3, respectively. The highest $PM_{2.5}$ concentration was measured in the Shiningbank Lake area with a one-hour concentration of 43 µg/m^3. Truck traffic was noted in the Shiningbank Lake area when this reading was recorded. The major source of large particulates in the Whitecourt, Swan

Hills and Shiningbank Lake areas was road dust from traffic near the monitoring sites. Industrial sources in the Whitecourt area are also sources of particulates.

Based on median concentrations, the highest particulate levels were measured at Site #3 (downtown Whitecourt), Site #4 (northwest industrial area of Whitecourt) and Site #5 (Whitecourt gas plant). Median TSP levels at these locations ranged from 99 to 171 $\mu g/m^3$. Median PM_{10} values at these sites ranged from 50 to109 $\mu g/m^3$ and median $PM_{2.5}$ concentrations ranged from 6 to 11 $\mu g/m^3$ at these sites.

The overall median TSP, PM_{10} and $PM_{2.5}$ concentrations were 47, 29 and 4 $\mu g/m^3$, respectively, based on all data collected in the Whitecourt/Swan Hills survey. Median TSP levels from other MAML surveys range from 4 $\mu g/m^3$ in the Caroline/Sundre survey to 74 $\mu g/m^3$ in the Bow Corridor survey. Median levels of PM_{10} ranged from 3 $\mu g/m^3$ in the Caroline/Sundre survey to 40 $\mu g/m^3$ in the Bow Corridor survey. $PM_{2.5}$ levels range from 1 to 4 $\mu g/m^3$ in other MAML surveys. These data are presented in Table A3 (page 30).

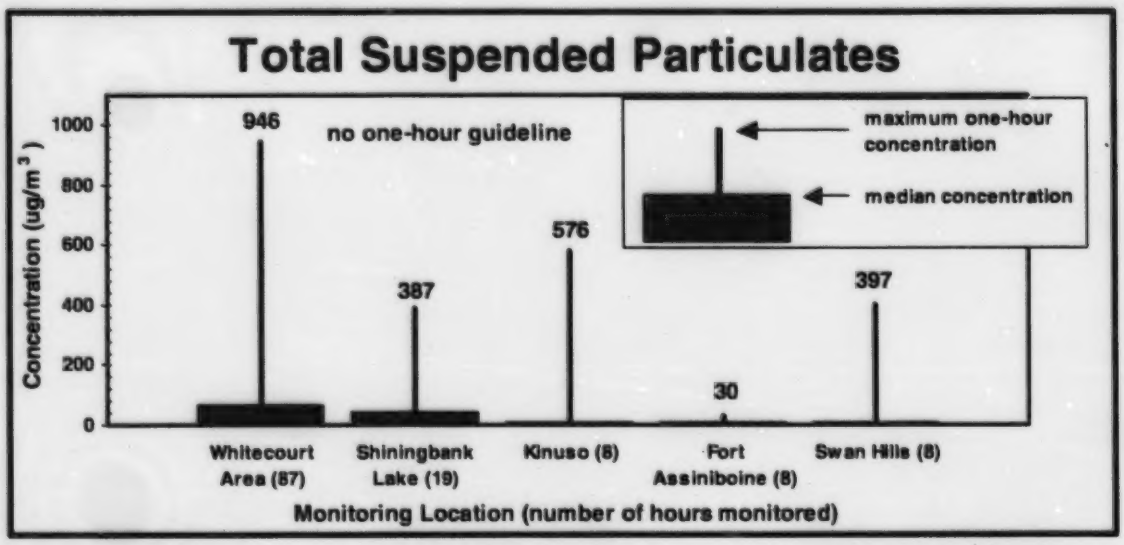

Figure 1.10 One-hour median and maximum concentrations for total suspended particulates.

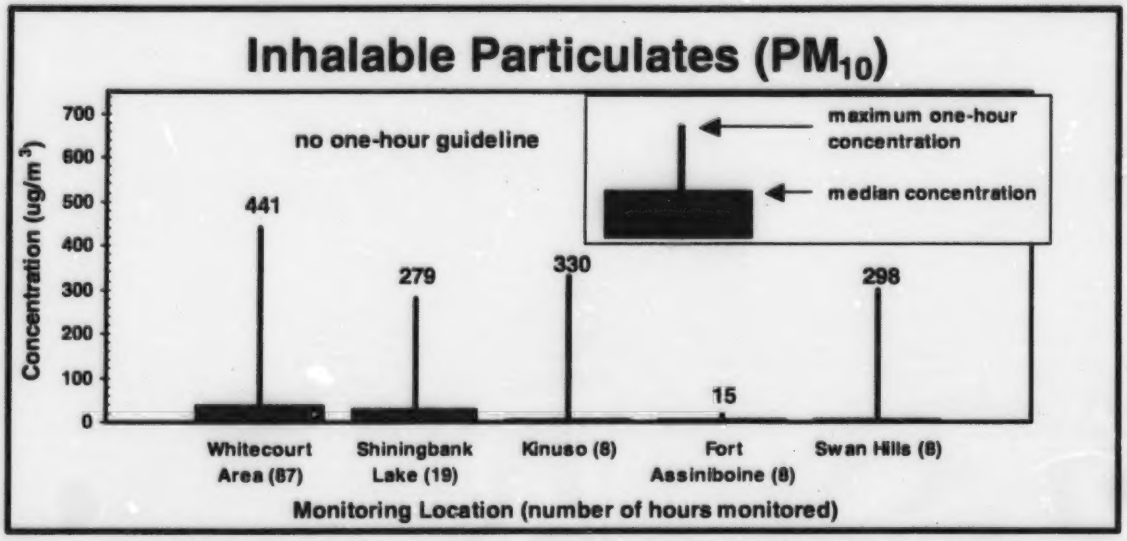

Figure 1.11 One-hour median and maximum concentrations for inhalable particulates (PM_{10}).

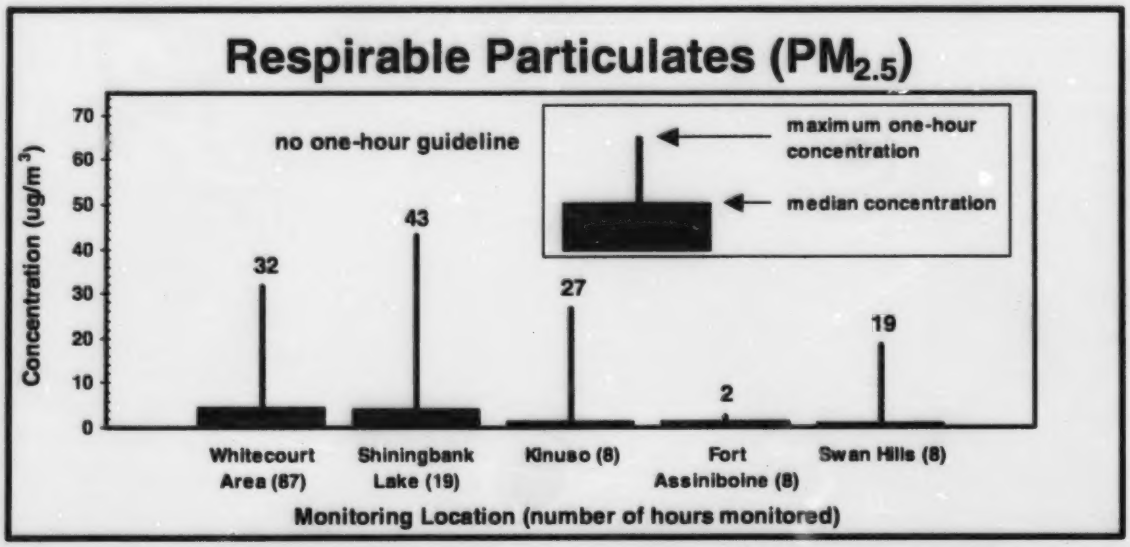

Figure 1.12 One-hour median and maximum concentrations for respirable particulates ($PM_{2.5}$).

Ozone (O_3)

maximum one-hour concentration recorded during survey	one-hour guideline
0.054 ppm	0.082 ppm (based on reduction of lung function and effects on tomatoes)

Ozone in the lower atmosphere is produced by the reaction of oxides of nitrogen and volatile organic compounds in the presence of sunlight, and transport of O_3 from the upper atmosphere to ground level. Transport from the upper atmosphere is likely the dominant ozone producing process in the fall, winter and early spring seasons. O_3 concentrations are generally lower in urban centres due to the destruction of O_3 by nitric oxide.

O_3 concentrations in the Whitecourt/Swan Hills survey were generally highest in the afternoon and in the spring and summer seasons. These daily and seasonal variations are typical of other locations in Alberta. The maximum one-hour O_3 concentration (0.054 ppm) was recorded from 1:28 p.m. to 2:27 p.m. on May 7, 2001 at Site #13 (Shiningbank Lake area). This value is 66 per cent of the one-hour guideline for O_3.

The median O_3 concentration in the survey area ranged from 0.020 ppm at Site #9 (Fort Assiniboine Ranger Station) to 0.033 ppm at Site #11 (Swan Hills Hospital). Lower O_3 concentrations were observed at sites that were monitored more frequently in the morning and higher levels were measured at sites that were monitored in the afternoon. Higher O_3 levels are normally observed in the afternoon because of more sunlight, warmer temperatures and more vertical mixing of the atmosphere. All of these factors lead to higher background O_3 levels.

The median O_3 concentration for the entire Whitecourt, Swan Hills and the Shiningbank Lake areas survey was 0.027 ppm. Typical median O_3 levels at rural locations in Alberta range from about 0.020 to 0.043 ppm based on 2001 data.

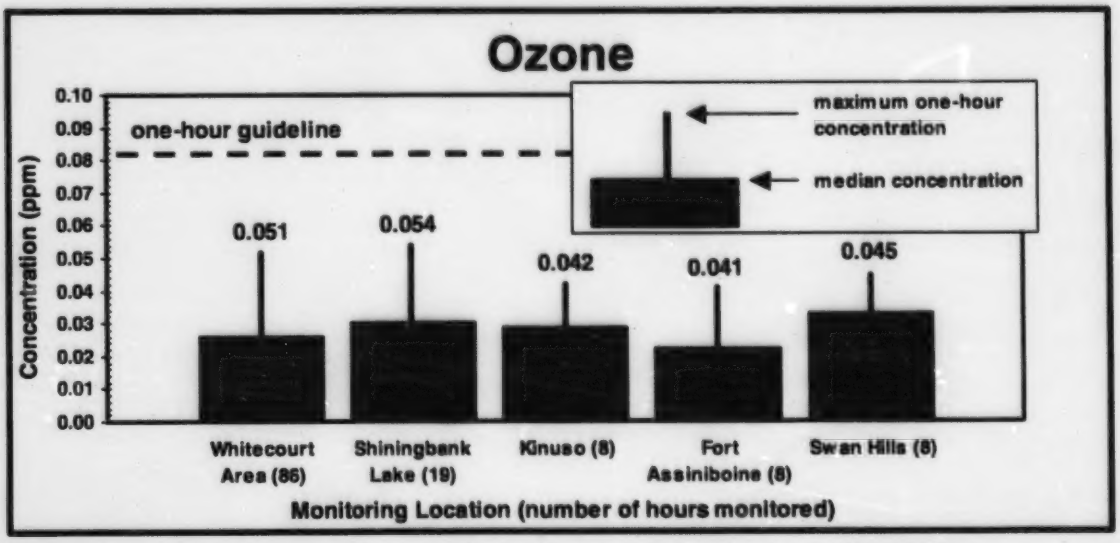

Figure 1.13 One-hour median and maximum concentrations for ozone.

Oxides of Nitrogen (NO_2, NO and NO_x)

maximum one-hour concentration recorded during survey	one-hour guideline
NO_2 = 0.030 ppm	0.212 ppm (based on odour perception)
NO = 0.112 ppm	no guideline
NO_x = 0.137 ppm	no guideline

Oxides of nitrogen (NO_x) are the total of nitrogen dioxide (NO_2) and nitric oxide (NO). During high temperature combustion - as in the burning of natural gas, coal, oil and gasoline - atmospheric nitrogen may combine with molecular oxygen to form NO. NO is colourless and odourless. Most NO in the ambient air is oxidized to form NO_2. NO_2 is a reddish-brown gas with a pungent odour. The major source of oxides of nitrogen in urban areas is vehicle exhaust emissions. Processes associated with the oil and gas industry also emit oxides of nitrogen into the atmosphere.

NO_2 concentrations were well below Alberta's air quality guidelines in the Whitecourt/Swan Hills area survey. The maximum NO_2 concentration was recorded at Site #13 (Shiningbank Lake area) on November 24, 2000 from 3:28 p.m. to 4:28 p.m. (0.030 ppm). This NO_2 concentration is 14 per cent of the one-hour guideline. This maximum value was measured downwind of the McLeod River facility. Maximum one-hour NO_2 concentrations typically range from 0.013 to 0.080 ppm at rural locations and from 0.065 to 0.150 ppm at urban locations in Alberta.

The overall median NO_2 concentration at all sites in the Whitecourt/Swan Hills area survey was 0.005 ppm. Median NO_2 levels at rural locations in Alberta generally range from 0.002 to 0.009 ppm. In Edmonton and Calgary, typical median NO_2 levels range from 0.013 to 0.025 ppm. The primary sources of oxides of nitrogen in the Whitecourt/Swan Hills area are emissions from vehicles and sources related to the oil and gas industry.

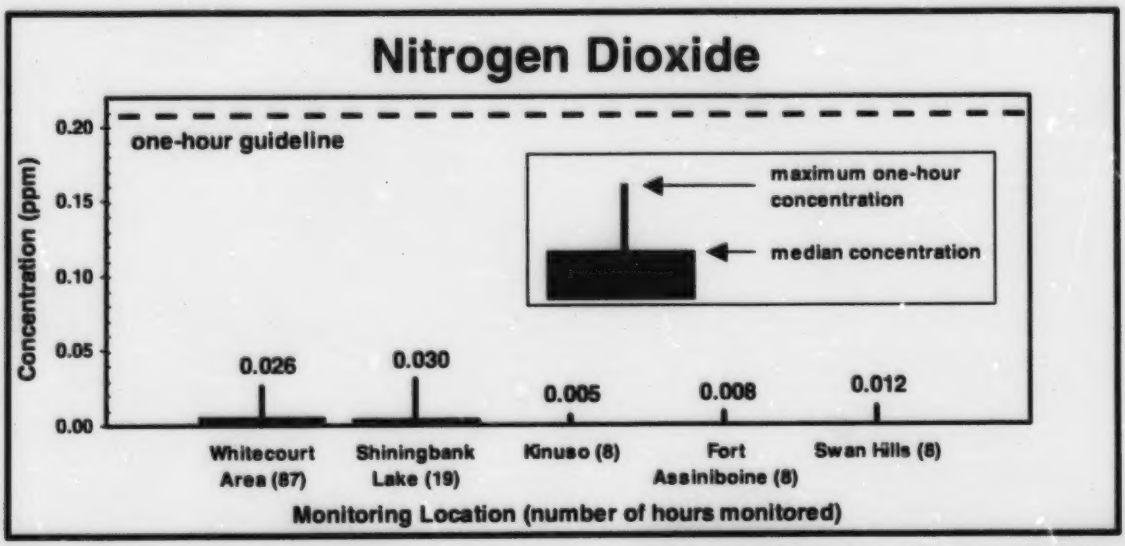

Figure 1.14 One-hour median and maximum concentrations for nitrogen dioxide.

Carbon Monoxide (CO)

maximum one-hour concentration recorded during survey	one-hour guideline
0.7 ppm	13.0 ppm (based on the oxygen-carrying capacity of blood)

Carbon monoxide (CO) is a colourless, odourless gas emitted into the atmosphere primarily by motor vehicles. Minor sources include fireplaces, industry, aircraft and natural gas combustion. The major source of carbon monoxide at urban locations is vehicle exhaust emissions.

CO values were low during at all locations monitored in the Whitecourt/Swan Hills area survey. The maximum one-hour concentration of 0.7 ppm was recorded at Site #3 (downtown Whitecourt) on November 21, 2000 from 6:15 p.m. to 7:15 p.m. This maximum one-hour concentration is 5 per cent of the one-hour guideline for CO. Maximum one-hour CO concentrations ranged from 0.9 to 2.8 ppm during other MAML monitoring surveys. Maximum CO levels ranged from 2.8 to 11.2 ppm in Edmonton and Calgary in 2001.

The overall median concentration in the Whitecourt/Swan Hills area survey was 0.2 ppm. Median CO concentrations at other mobile surveys in Alberta ranged from 0.2 to 0.4 ppm. At urban locations such as Edmonton and Calgary, median CO levels ranged from 0.3 to 0.5 ppm (based on 2001 data). The major source of CO at urban locations is vehicle exhaust emissions. CO is also be emitted by combustion processes associated with the oil and gas industry.

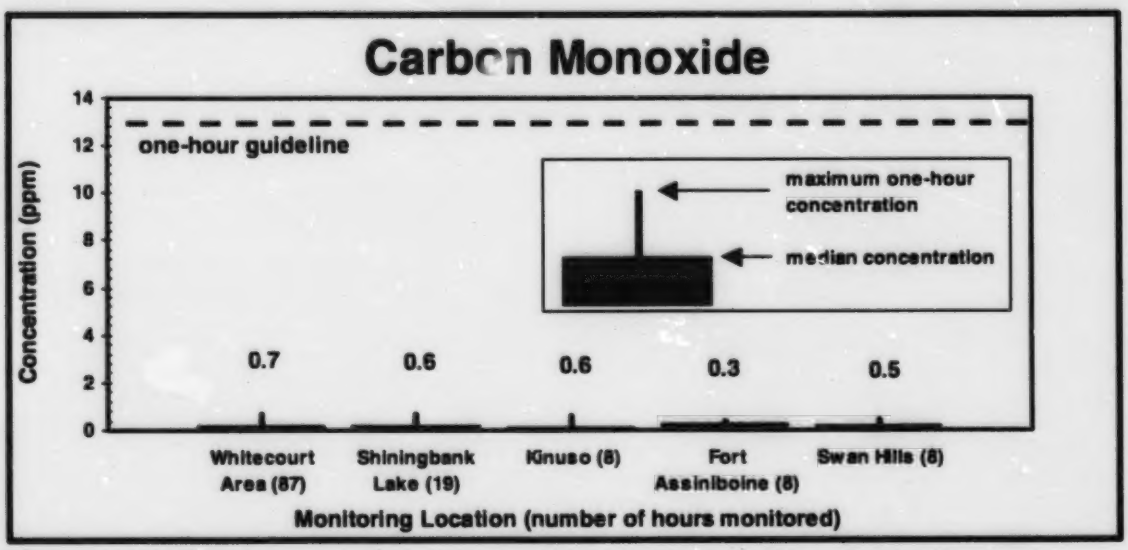

Figure 1.15 One-hour median and maximum concentrations for carbon monoxide.

Polycyclic Aromatic Hydrocarbons (PAHs)

maximum one-hour concentration recorded during survey	one-hour guideline
113 ng/m^3	no guideline

Polycyclic aromatic hydrocarbons (PAHs) are a class of chemicals that are usually contained in soot and smoke. There are more than 100 different PAHs with varying levels of toxicity. They are formed during the incomplete combustion of gasoline, diesel, oil, coal, wood, garbage or other organic substances. Tobacco smoke and charbroiled meats are common sources of PAHs. Other outdoor PAH sources include vehicle exhaust emissions, wood smoke from fireplaces, smoke from forest fires and industrial facilities. PAHs occur in the atmosphere in the vapour phase or attached to dust particles. The PAH monitoring instrument aboard the MAML will analyze only particulate bound PAHs.

The highest PAH levels were measured in Whitecourt during the survey. The maximum one-hour average PAH concentration of 113 ng/m^3 (nanograms per cubic metre) was recorded at Site #3 (downtown Whitecourt) on November 23, 2000 from 9:20 a.m. to 10:19 a.m. The second and third highest PAH concentrations were measured in Whitecourt at Site #3 (60 ng/m^3), Site #4 (50 ng/m^3) and Site #1 (26 ng/m^3). Site #4 was located in the northwest industrial area and Site #1 was located in the southeast industrial area of Whitecourt. Maximum PAH levels measured during previous air quality surveys in Alberta ranged from 11 ng/m^3 in the Lethbridge area to 36 ng/m^{3}in the Bow Corridor. Higher PAH levels in Whitecourt were likely due to emissions from vehicles and industry during stagnant weather conditions.

Median PAH concentrations ranged from 0.3 ng/m^3 in Fort Assiniboine to 2.0 ng/m^3 in Whitecourt. PAHs are not routinely monitored on an hourly basis at air monitoring stations in Alberta.

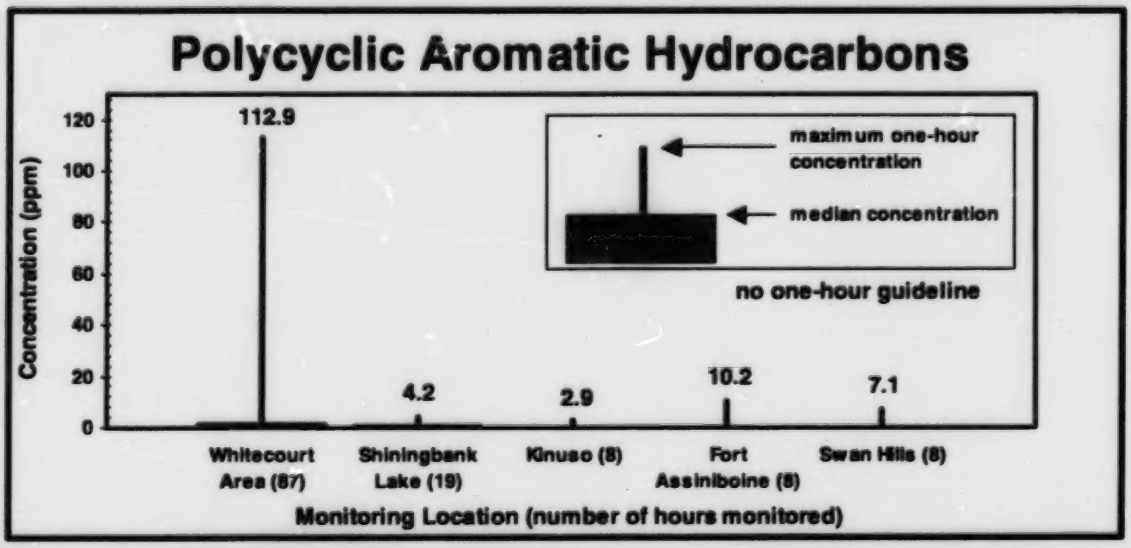

Figure 1.16 One-hour median and maximum concentrations for polycyclic aromatic hydrocarbons.

Ammonia (NH_3)

maximum one-hour concentration recorded during survey	one-hour guideline
0.013 ppm	2.0 ppm (based on odour perception)

Ammonia is a colourless gas with the well-known pungent odour found in household cleaners. NH_3 is produced both by natural and man-made sources. Some natural sources of NH_3 include the decay of plant material and animal waste. A small portion is also released during respiration. In Alberta, the fertilizer industry is the main industrial source of NH_3. The industry produces synthetic NH_3 for either direct application to soil as a fertilizer, or as a raw material for use in the production of other high nitrogen fertilizer products. The other major source of NH_3 is commercial feedlots, specifically from their large amounts of animal waste.

Ammonia levels in the Whitecourt/Swan Hills area survey were very low at all monitoring sites. The highest one-hour NH_3 concentration detected during the survey (0.013 ppm) was measured at Site #13 from 3:00 p.m. to 4:00 p.m. on May 7, 2001. This concentration is less than one per cent of the one-hour guideline. Maximum one-hour NH_3 concentrations from other MAML surveys ranged from 0.020 ppm (in the City of Lethbridge) to 1.364 ppm (in the area north of Lethbridge).

The overall median NH_3 concentration at all sites was also very low with a value 0.001 ppm. Median NH_3 concentrations from other MAML air quality surveys conducted in Alberta ranged from 0.001 to 0.075 ppm.

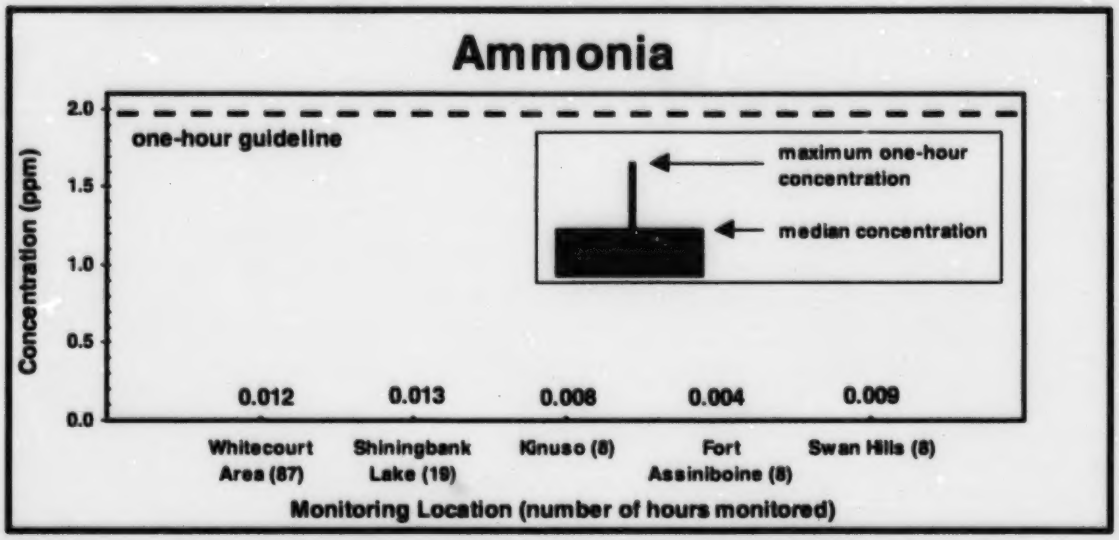

Figure 1.17 One-hour median and maximum concentrations for ammonia.

Part 2: Dioxin, Furan and PCB Monitoring

Dioxins, furans and polychlorinated biphenyls (PCBs) were monitored in the communities of Kinuso, Fort Assiniboine and Swan Hills and also near the Swan Hills Treatment Centre (SHTC). Air samples were collected at these locations from November 2000 to February 2001. All samples analyzed for dioxins, furans and PCBs were collected while the SHTC was in operation.

Monitoring Method

Dioxin, furan and PCB samples were collected for a 24-hour time period in the Swan Hills area. A total of 41 24-hour samples were collected from November 2000 to February 2001. Samples to be analyzed were selected based on one or more of the following criteria:

(1) the SHTC was in operation,
(2) winds were from the SHTC for at least 20% of the 24-hour monitoring period,
(3) a plant upset was recorded on the sampling date,
(4) a background sample was required, or
(5) a field blank sample was required.

Of the 41 samples collected, 20 samples were analyzed for dioxins, furans and PCBs. These 20 analyzed samples were collected at the following locations:

- Kinuso (six samples including one blank and one background sample),
- Fort Assiniboine (five samples including one background sample),
- Swan Hills (three samples including one background sample), and
- the SHTC (six samples including one field blank and one background sample).

Monitoring Equipment

Air samples were collected using the PUF (polyurethane foam) sampler developed by Environment Canada. The sampler consists of a polyurethane foam head attached to a vacuum pump system and works on the same principle as the conventional high-volume sampler. The polyurethane foam is housed inside of a stainless steel cylinder within a PVC cartridge with Teflon seals and end caps. The air sample is collected by drawing a known volume of air through the polyurethane foam and a pre-weighed filter for a 24-hour time period. The polyurethane foam will capture chemicals such as dioxins, furans and PCBs in the vapour phase. The filter will capture these chemicals in the particulate phase.

The PUF samples were analyzed for dioxin and furan congeners using capillary high-resolution gas chromatography and high-resolution mass spectrometry. Coplanar PCBs concentrations were obtained from the PUF samples using high-pressure liquid chromatography and GC-MSD. Laboratory analysis was conducted by the Analysis and Methods Division and the Environment Canada Environmental Technology Centre in Ottawa.

Monitoring Sites

The monitoring locations in the Swan Hills area are indicated in Figure 1.2 (page 5). Photographs of these locations are indicated in Figure 2.1. The following is a description of each monitoring site.

Swan Hills: The town of Swan Hills is located 12 km southwest of the SHTC. The monitoring site was on the roof of the Swan Hills Hospital in the north edge of town. There is residential and hospital traffic in the area. Highway #33 is located on the west edge of Swan Hills less than one km from the Swan Hills Hospital.

Kinuso: The community of Kinuso is located about 65 km north-northwest of the SHTC. The monitoring site was on the roof of the Kinuso school. There is light local traffic in the vicinity of the monitoring site. Highway #2 is located about three km south of Kinuso.

Fort Assiniboine: Fort Assiniboine is located approximately 60 km southeast of the SHTC. The monitoring site was located at the Alberta Forest Service facility about three km northwest of Fort Assiniboine on Highway #33. The monitoring site was situated 200 m south of the highway. There is light traffic along Highway #33 and in the Alberta Forest Service facility parking lot.

SHTC: This site was located on the southeast edge of the plant site less than one km from the incinerator stack, rotary kiln stack and large kiln stack. There is light traffic along the secondary road passing the monitoring site.

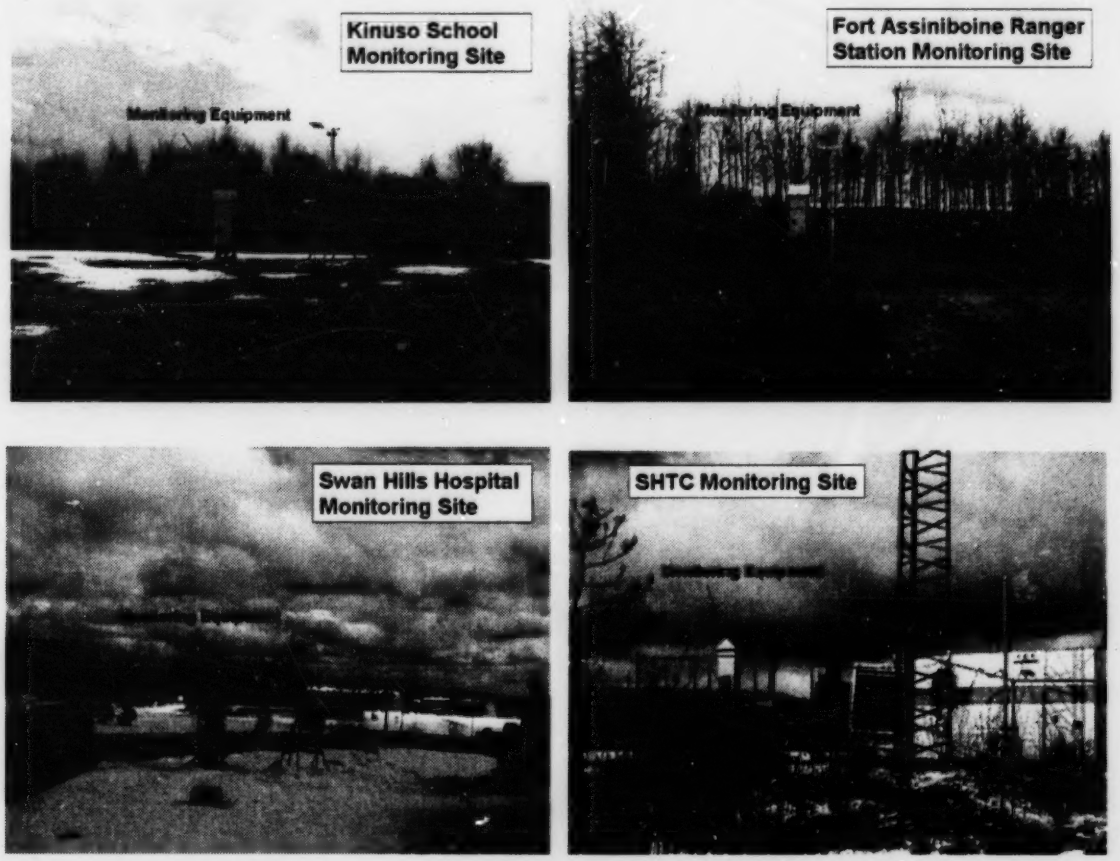
Kinuso School Monitoring Site
Fort Assiniboine Ranger Station Monitoring Site
Swan Hills Hospital Monitoring Site
SHTC Monitoring Site

Figure 2.1 Photographs of dioxin, furan and PCB monitoring sites.

Data Analysis

The results of monitoring in the Swan Hills area are presented in terms of toxic equivalents (TEQs) of dioxins and furans, total dioxins, total furans and total PCBs (normalized by compounds within each homologue group). Analysis results for TEQs of dioxins and furans, total dioxins, total furans and total PCBs from these samples are indicted in Table 2.1.

Air quality concentrations in these samples are presented relative to two similar surveys conducted at the same locations in 1997 and 1998. Concentrations of dioxins, furans and PCBs are also presented relative to levels measured at other locations in Alberta and Canada. These data are presented in Table 2.2. Concentrations are presented as picograms (1×10^{-12} grams) of dioxins or furans per cubic metre of air (pg/m^3). Concentrations of PCBs are presented in units of nanograms (1×10^{-9} grams) of PCBs per cubic metre of air.

Wind direction and wind speed were also monitored at the Kinuso, Fort Assiniboine, Swan Hills and SHTC monitoring sites. Wind data are presented in Table 2.3.

Toxic Equivalents (TEQs) of Dioxins and Furans

Dioxins are a family of chemicals consisting of 75 distinct compounds. Furans are a family of chemicals closely related to dioxins consisting of 135 separate compounds. Individual dioxins and furans have varying levels of toxicity.

Dioxins and furans originate in the atmosphere as by-products of any process that involves the incomplete combustion of materials containing chlorine and organic matter. Some common industrial sources include pesticide production, wood preservative production, and the bleaching process used for some pulp and paper mills. Forest fires are also believed to contribute to dioxins and furans in the environment. Since dioxins and furans can be transported over large distances, low concentrations of these chemicals can exist in the background atmosphere. The major source of dioxins and furans in the Swan Hills area is the SHTC. Minor sources may include forest fires and long-range transport.

Toxic equivalents (TEQs) are calculated based on international toxicity equivalency factors for 17 dioxin and furan isomers and are presented in terms of tetrachlorodibenzo-p-dioxin. The international toxic equivalency factors for each isomer are indicated in Table 2.4.

Results for TEQs of Dioxins and Furans

Figure 2.2 shows TEQs in the Swan Hills survey from November 2000 to February 2001. TEQ levels measured in the Swan Hills area during the 2000/01 monitoring survey were low in all samples collected. The average TEQ value based on all samples analyzed was 0.007 pg/m^3. The average TEQ concentration based on samples collected in the 1997/98 survey was about two times higher with an average value of 0.013 pg/m^3. The maximum TEQ concentration measured in the 2000/01 survey (0.032 pg/m^3) was also much lower than the maximum value measured the 1997/98 survey (0.117 pg/m^3). The 1997/98 survey included samples that were taken after an explosion that occurred at the SHTC in July 1997 and during a forest fire that occurred in the Swan Hills area in the spring of 1998. These events would likely account for the higher dioxin and furan levels in 1997 and 1998.

Table 2.1 Analysis results for dioxins, furans and PCBs in the Swan Hills area.

Sample Date	Location	TEQs for Dioxins and Furans (pg/m^3)	Total Dioxins (pg/m^3)	Total Furans (pg/m^3)	Total PCBs (ng/m^3)	Reason for Analyzing Sample
5-Nov-00	Kinuso	0.014	0.242	0.355	0.0012	some winds from plant
6-Dec-00	Kinuso	0.000	0.053	0.003	0.0010	plant upset
17-Dec-00	Kinuso	0.003	0.181	0.015	0.0003	background
8-Jan-01	*Kinuso*	*nd*	*nd*	*nd*	*0.0003*	*field blank*
9-Jan-01	Kinuso	0.009	0.407	0.130	0.0007	some winds from plant
31-Jan-01	Kinuso	0.002	0.088	0.017	0.0006	some winds from plant
7-Nov-00	Fort Assiniboine	0.032	2.213	0.258	0.0007	background
6-Dec-00	Fort Assiniboine	0.002	0.135	0.010	0.0006	plant upset
12-Dec-00	Fort Assiniboine	0.011	0.606	0.110	0.0007	some winds from plant
14-Jan-01	Fort Assiniboine	0.005	0.303	0.025	0.0005	some winds from plant
16-Jan-01	Fort Assiniboine	0.000	0.021	0.002	0.0005	some winds from plant
6-Dec-00	Swan Hills	0.001	0.076	0.015	0.0004	plant upset
12-Dec-00	Swan Hills	0.001	0.094	0.011	0.0007	background
9-Jan-01	Swan Hills	0.000	0.061	0.002	0.0006	some winds from plant
7-Nov-00	SHTC	0.016	1.068	0.079	0.0012	background
13-Nov-00	SHTC	0.002	0.083	0.039	0.0091	some winds from plant
6-Dec-00	SHTC	0.008	0.072	0.231	0.0219	plant upset
8-Jan-01	*SHTC*	*nd*	*nd*	*nd*	*0.0004*	*field blank*
31-Jan-01	SHTC	0.008	0.464	0.220	0.0245	some winds from plant
19-Feb-01	SHTC	0.011	0.344	0.299	0.0463	some winds from plant
Average		**0.007**	**0.362**	**0.101**	**0.006**	
Maximum		**0.032**	**2.213**	**0.355**	**0.046**	

pg/m^3 - picogram per cubic metre (a picogram is $1x10^{-12}$ grams)
ng/m^3 - nanogram per cubic metre (a nanogram is $1x10^{-9}$ grams)
italics - field blank samples are not included in average calculations
nd - not detected in air sample

Table 2.2 Dioxins, furans and PCBs concentrations in the 2000/01 Swan Hills area survey, 1997/98 Swan Hills surveys as well as other Alberta and Canadian locations.

Location	Toxic Equivalents		Total Dioxins		Total Furans		Total PCBs		# of Samples
	pg/m^3		pg/m^3		pg/m^3		ng/m^3		
	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	
Kinuso (2000/01)	0.006	0.014	0.194	0.407	0.104	0.355	0.001	0.001	6
Kinuso (1997/98)	0.005	0.017	0.361	1.134	0.046	0.107	0.009	0.024	15
Fort Assiniboine (2000/01)	0.010	0.032	0.656	2.213	0.081	0.258	0.001	0.001	5
Fort Assiniboine (1997/98)	0.006	0.020	0.121	0.361	0.024	0.129	0.001	0.007	18
Swan Hills (2000/01)	0.001	0.001	0.077	0.094	0.009	0.015	0.001	0.001	3
Swan Hills (1997/98)	0.005	0.022	0.203	1.471	0.026	0.084	0.001	0.009	16
SHTC (2000/01)	0.009	0.016	0.406	1.068	0.174	0.299	0.021	0.046	6
SHTC (1997/98)	0.039	0.117	1.053	4.103	1.156	2.841	71.899	163.010	14
Swan Hills Area Survey (2000/01)	**0.007**	**0.032**	**0.362**	**2.213**	**0.101**	**0.355**	**0.006**	**0.046**	**20**
Swan Hills Area Survey (1997/98)	**0.013**	**0.117**	**0.406**	**4.103**	**0.281**	**2.841**	**15.980**	**163.010**	**63**
Edmonton Central Station	0.048	0.050	0.478	0.656	0.017	0.034	no data	no data	2
Edmonton East Station	0.200	0.394	3.730	6.071	2.987	9.007	no data	no data	4
Fort Saskatchewan Station	0.055	0.089	1.309	3.125	0.452	1.167	no data	no data	5
Fort McMurray Station	0.076	0.084	0.184	0.234	0.013	0.025	no data	no data	2
All Alberta Stations	0.102	0.394	1.753	6.071	1.097	9.007	no data	no data	13
All Canadian Stations	0.060	0.543	n/a	n/a	n/a	n/a	no data	no data	220

n/a data not available

Table 2.3 Wind direction and speed at monitoring sites when samples were analyzed.

Sample Date	Location	% of time Winds were from the SHTC	Predominant Wind Directions	Average Wind Speed (km/h)	Reason for Analyzing Sample
5-Nov-00	Kinuso	29%	east and southeast	3.8	some winds from plant
6-Dec-00	Kinuso	0%	southwest and west	6.8	plant upset
17-Dec-00	Kinuso	0%	west to northwest	6.2	background
9-Jan-01	Kinuso	25%	southeast to east-northeast	2.1	some winds from plant
31-Jan-01	Kinuso	29%	east to southeast and northwest	3.9	some winds from plant
7-Nov-00	Fort Assiniboine	0%	southeast	3.0	background
6-Dec-00	Fort Assiniboine	8%	west-northwest	5.5	plant upset
12-Dec-00	Fort Assiniboine	21%	west-northwest to north	0.2	some winds from plant
14-Jan-01	Fort Assiniboine	25%	west to northwest	1.4	some winds from plant
16-Jan-01	Fort Assiniboine	25%	west to northwest	1.7	some winds from plant
6-Dec-00	Swan Hills	0%	west-northwest and some southeast	24.1	plant upset
12-Dec-00	Swan Hills	0%	west to northwest	7.8	background
9-Jan-01	Swan Hills	21%	southwest to west-northwest and south-southeast to east	5.6	some winds from plant
7-Nov-00	SHTC	0%	south-southwest to south-southeast	7.1	background
13-Nov-00	SHTC	67%	northwest and west-northwest	14.3	winds from plant
6-Dec-00	SHTC	100%	west-northwest to north-northwest	38.6	plant upset/winds from plant
31-Jan-01	SHTC	29%	southwest to south and west to northwest	17.5	some winds from plant
19-Feb-01	SHTC	92%	west to northwest	19.7	winds from plant

SHTC wind data from 30 m tower.

Table 2.4 International toxicity equivalency factors for dioxin and furan isomers.

Dioxin/Furan Isomer	International Toxicity Equivalency Factor
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1.0
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.5
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,4,6,7,8-Hepachlorodibenzo-p-dioxin	0.01
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	0.001
2,3,7,8-Tetrachlorodibenzofuran	0.1
2,3,4,7,8-Pentachlorodibenzofuran	0.5
1,2,3,7,8-Pentachlorodibenzofuran	0.05
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01
1,2,3,4,6,7,8,9-Octachlorodibenzofuran	0.001

Source: Summary of point of impingement standards, ambient air quality criteria (AAQCs), and approvals screening levels (ASLs). Standards Development Branch, Ontario Ministry of the Environment and Energy. June 1994.

Average TEQ values from samples collected in the Swan Hills area in 2000/01 were also lower than those recorded at other Alberta locations. Average TEQ concentrations at Kinuso, Fort Assiniboine, Swan Hills and the SHTC were 0.006, 0.010, 0.001 and 0.009 pg/m^3, respectively. These average values are much lower than the average TEQ concentration measured at other locations in Alberta (0.102 pg/m^3) and Canada (0.060 pg/m^3). The Alberta average is based on 13 samples collected in 1994 and 1995 at the Edmonton Central, Edmonton East, Fort Saskatchewan and Fort McMurray stations. The Canadian average is based on 220 samples collected by a federal-provincial program from 1994 to 1997 at urban, rural and industrial locations.

The highest TEQ value was measured in a sample collected on November 7 in Fort Assiniboine. The TEQ level measured in this sample was 0.032 pg/m^3. This peak value was measured in a background sample when winds were not from the SHTC (see Table 2.3). Therefore, the cause of dioxins and furans in this sample was likely due to another source such as burning of plastic materials that contain chlorine and organic substances. The maximum TEQ concentration measured in Fort Assiniboine (0.032 pg/m^3) was very low compared to maximum TEQ values recorded at other Alberta (0.394 pg/m^3) and Canadian locations (0.543 pg/m^3).

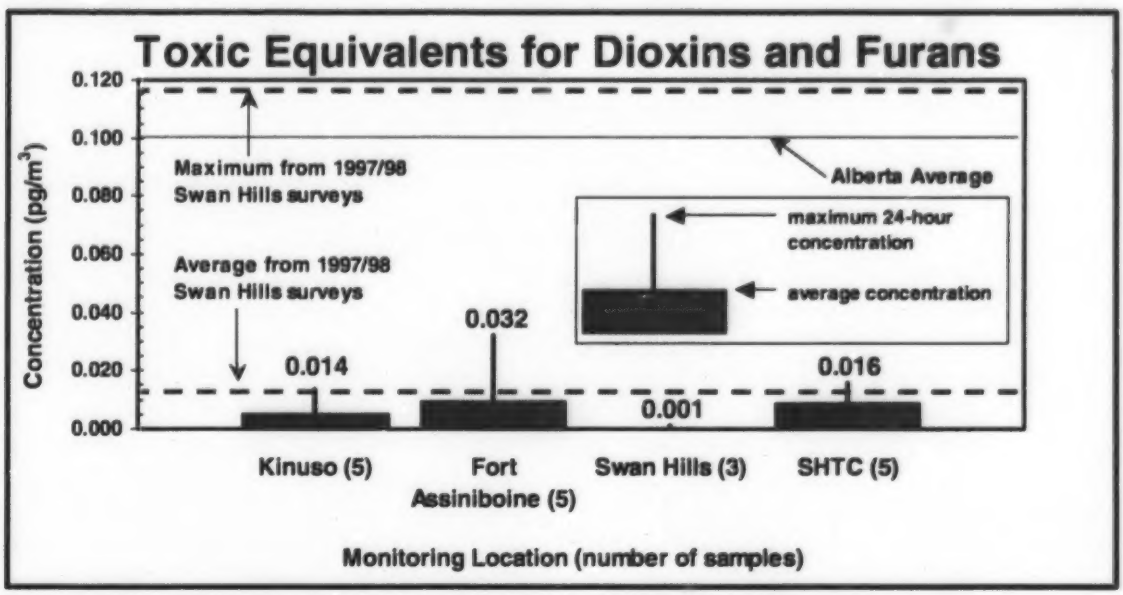

Figure 2.2 TEQs for dioxins and furans in the Swan Hills area.

Results for Total Dioxins

Total dioxin concentrations from samples collected in the Swan Hills area are indicated in Figure 2.3. Average total dioxin levels in Kinuso, Fort Assiniboine, Swan Hills and the SHTC were 0.194, 0.656, 0.077 and 0.406 pg/m^3, respectively. The overall average for all samples collected in the 2000/01 Swan Hills survey (0.362 pg/m^3) was lower than the total dioxin concentration recorded in the 1997/98 Swan Hills survey (0.406 pg/m^3). Average total dioxin concentrations measured in the Swan Hills area were lower than the overall average value measured in Alberta (1.753 pg/m^3).

The maximum total dioxin concentration was measured in Fort Assiniboine on November 7. This maximum concentration (2.213 pg/m^3) was much lower than maximum levels measured at other Alberta (6.071 pg/m^3) locations. The sample collected on November 7 in Fort Assiniboine was likely influenced local burning of a substance containing chlorine and organic materials. Winds in Fort Assiniboine on November 7 were not from the SHTC.

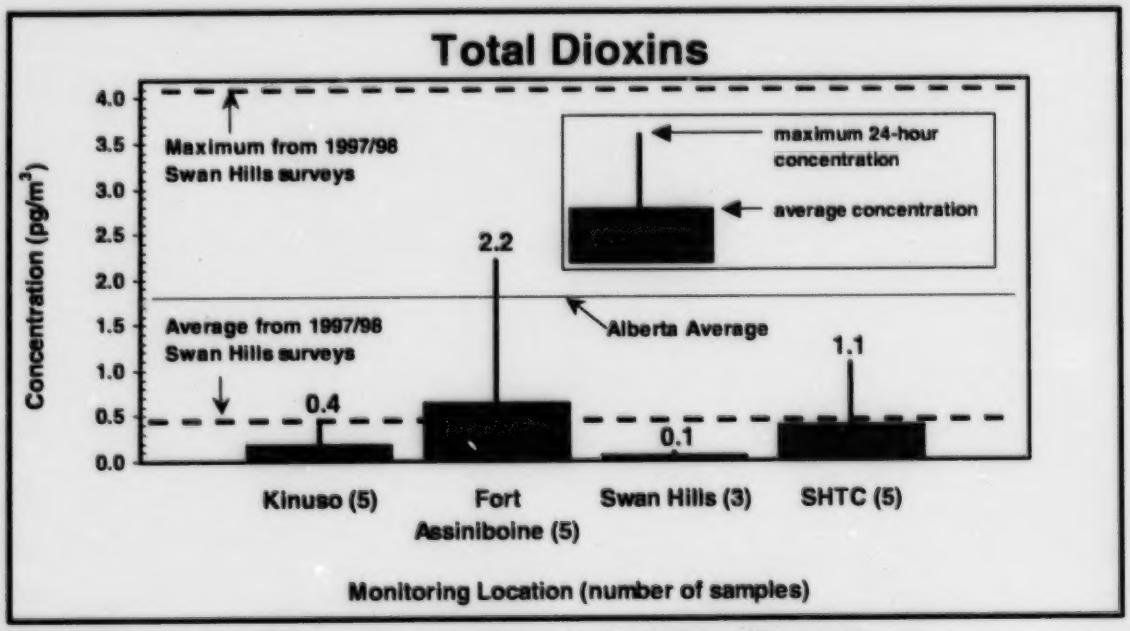

Figure 2.3 Total dioxin concentrations in the Swan Hills area.

Results for Total Furans

Total furan concentrations in the Swan Hills area are indicated in Figure 2.4. Average total furan concentrations in Kinuso, Fort Assiniboine, Swan Hills and the SHTC were 0.104 pg/m^3, 0.081 pg/m^3, 0.009 pg/m^3 and 0.174 pg/m^3, respectively. The average concentration from the 2000/01 survey (0.101 pg/m^3) was much lower than the average total furans level measured in the 1997/98 Swan Hills survey (0.281 pg/m^3).

The maximum total furan concentration was measured in Kinuso on November 5. Winds in Kinuso were from the SHTC almost 30 per cent of the time November 5 (see Table 2.3). The maximum value measured in Kinuso (0.355 pg/m^3) was much lower than the maximum total furan concentration measured in the 1997/98 Swan Hills survey (2.841 pg/m^3). The total furan concentration measured in Kinuso on November 5 was also much lower than the maximum measured at other Alberta locations (9.007 pg/m^3).

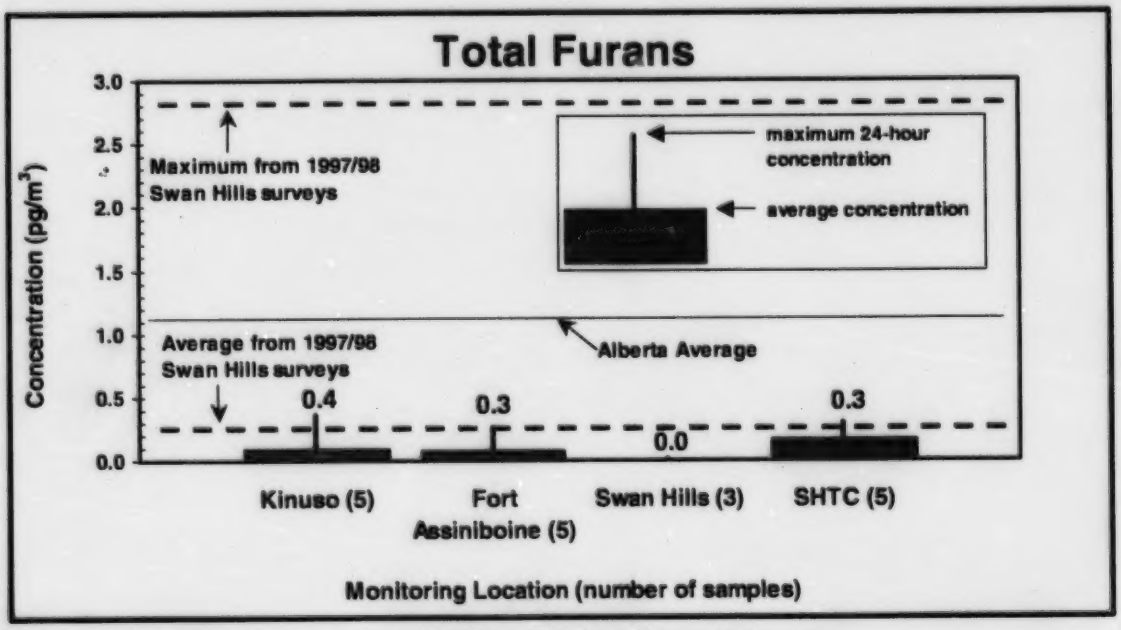

Figure 2.4 Total furan concentrations in the Swan Hills area.

Polychlorinated Biphenyls (PCBs)

PCBs are a family of chemicals consisting of over 200 individual compounds with varying levels of toxicity. In the past, PCBs were used as coolants and lubricants in transformers, capacitors and other electrical equipment because of their insulating and non-flammable properties. Because of evidence that PCBs accumulate in the environment and may cause health hazards, PCBs are no longer manufactured in Canada or the United States. The only source of PCBs in the Swan Hills area is fugitive emissions or leakages during the destruction of PCBs at the SHTC.

Results for Total PCBs

Average total PCB concentrations were very low at Kinuso, Fort Assiniboine and Swan Hills on all sampling days (Figure 2.5). The average PCB concentration from samples collected in Kinuso, Fort Assiniboine and Swan Hills was 0.001 ng/m^3. The average PCB concentration near the SHTC was 0.021 ng/m^3.

PCB levels in the 2000/01 Swan Hills survey were much lower than those measured in the 1997/98 surveys. The average and maximum PCB concentrations measured in the 2000/01 survey were 0.006 and 0.046 ng/m^3, respectively. These values are substantially lower than average (15.980 ng/m^3) and maximum (163.010 ng/m^3) PCB levels measured in the 1997/98 survey. The 1997 Swan Hills survey was undertaken before and after an explosion at the SHTC in July 1997. This event caused elevated PCB levels during the 1997 Swan Hills survey.

The maximum 24-hour PCB concentration recorded during the survey was 0.046 ng/m^3 and was measured on February 19 near the SHTC. This maximum value is almost negligible compared to the Ontario 24-hour Ambient Air Quality Criteria for PCBs of 150 ng/m^3.

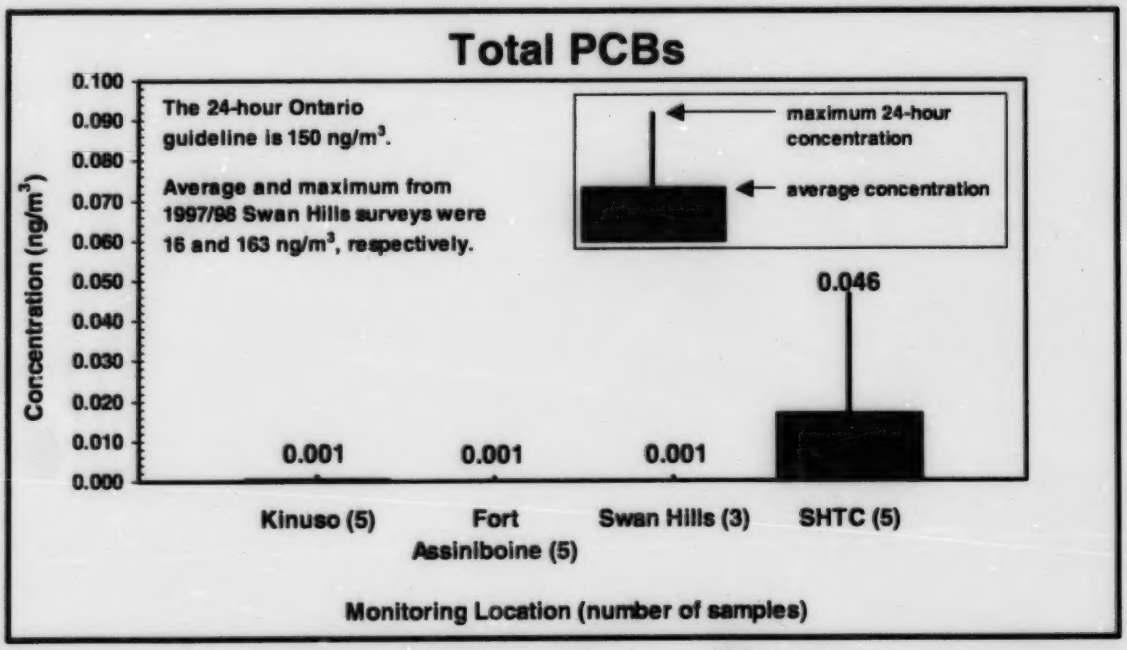

Figure 2.5 Total PCB concentrations in the Swan Hills area.

Appendix – Data Collected by the Mobile Air Monitoring Laboratory

Table A1: Median one-hour air pollutant concentrations at each monitoring site in the Whitecourt/Swan Hills area survey.

Area (# of hours monitored)	Area (# of hours monitored)	CO	O_3	THC	CH_4	RHC	SO_2	NO	NO_2	NO_X	NH_3	TRS	H_2S	TSP	PM_{10}	$PM_{2.5}$	PAH
		ppm	ppm		ppm		ppm		ppm		ppm	ppm	ppm		ug/m^3		ng/m^3
Whitecourt (93)	Site # 1 (17)	0.3	0.021	2.1	2.0	0.2	0.002	0.004	0.006	0.011	0.002	0.001	0.000	74	48	6	4
	Site # 2 (15)	0.3	0.021	2.1	2.0	0.2	0.002	0.004	0.006	0.011	0.002	0.001	0.000	74	48	6	4
	Site # 3 (16)	0.3	0.024	2.5	2.0	0.5	0.002	0.006	0.006	0.010	0.001	0.001	0.000	123	56	6	4
	Site # 4 (16)	0.2	0.027	2.3	2.0	0.2	0.001	0.002	0.004	0.006	0.001	0.001	0.000	99	50	7	2
	Site # 5 (8)	0.1	0.024	2.2	2.0	0.3	0.004	0.003	0.005	0.009	0.001	0.001	0.000	171	109	11	1
	Site # 6 (5)	0.3	0.025	2.5	2.2	0.4	0.025	0.008	0.009	0.015	0.003	0.002	0.001	17	9	2	0
	Site # 7 (9)	0.1	0.022	2.3	2.1	0.2	0.002	0.009	0.007	0.014	0.002	0.001	0.000	53	37	6	4
	Site # 8 (7)	0.2	0.029	2.1	1.9	0.3	0.001	0.003	0.003	0.006	0.001	0.001	0.001	19	13	2	1
Overall median (Whitecourt)		0.2	0.026	2.4	2.0	0.3	0.002	0.003	0.005	0.009	0.001	0.001	0.000	71	37	5	2
Fort Assiniboine (8)	Site # 9 (4)	0.3	0.020	2.3	2.1	0.1	0.000	0.004	0.003	0.008	0.001	0.000	0.000	10	7	2	1
	Site # 10 (4)	0.2	0.030	2.2	2.0	0.1	0.000	0.001	0.001	0.001	0.001	0.000	0.000	13	9	2	0
Swan Hills (8)	Site # 11 (8)	0.2	0.033	2.1	1.9	0.4	0.000	0.000	0.001	0.002	0.000	0.000	0.000	10	6	1	0
Kinuso (8)	Site # 12 (8)	0.2	0.029	2.2	2.0	0.2	0.000	0.002	0.001	0.002	0.002	0.000	0.000	13	8	2	1
Overall median (Swan Hills area)		0.2	0.030	2.1	2.0	0.2	0.000	0.001	0.001	0.002	0.001	0.000	0.000	11	7	2	1
Shiningbank Lake Area (19)	Site # 13 (19)	0.2	0.031	2.2	2.1	0.5	0.001	0.003	0.005	0.008	0.003	0.000	0.000	49	32	4	1
Overall median (Shiningbank)		0.2	0.031	2.2	2.1	0.5	0.001	0.003	0.005	0.008	0.003	0.000	0.000	49	32	4	1
Overall median		**0.2**	**0.027**	**2.3**	**2.0**	**0.3**	**0.004**	**0.003**	**0.005**	**0.008**	**0.001**	**0.001**	**0.000**	**47**	**29**	**4**	**1**

Table A2: Maximum one-hour air pollutant concentrations at each monitoring site in the Whitecourt/Swan Hills area survey.

Area (# of hours monitored)	Area (# of hours monitored)	CO	O_3	THC	CH_4	RHC	SO_2	NO	NO_2	NO_X	NH_3	TRS	H_2S	TSP	PM_{10}	$PM_{2.5}$	PAH
		ppm	ppm		ppm		ppm		ppm		ppm	ppm	ppm		ug/m^3		ng/m^3
Whitecourt (93)	Site # 1 (17)	0.5	0.045	2.9	2.3	0.8	0.006	0.046	0.026	0.073	0.005	0.003	0.001	214	126	13	26
	Site # 2 (15)	0.6	0.051	2.7	2.2	0.7	0.009	0.046	0.016	0.063	0.004	0.003	0.001	303	157	15	20
	Site # 3 (16)	0.7	0.041	3.0	2.3	0.8	0.006	0.103	0.022	0.126	0.004	0.003	0.001	696	388	32	113
	Site # 4 (16)	0.6	0.048	4.3	2.3	2.5	0.007	0.112	0.026	0.137	0.006	0.003	0.001	946	441	31	50
	Site # 5 (8)	0.3	0.051	2.7	2.2	0.5	0.013	0.008	0.011	0.017	0.005	0.001	0.001	585	308	26	8
	Site # 6 (5)	0.6	0.032	2.9	2.5	0.6	0.046	0.008	0.011	0.017	0.012	0.005	0.003	34	22	3	3
	Site # 7 (9)	0.5	0.050	2.7	2.2	0.8	0.005	0.065	0.013	0.075	0.010	0.005	0.001	270	142	13	22
	Site # 8 (7)	0.3	0.045	2.5	2.1	0.6	0.007	0.006	0.008	0.015	0.003	0.004	0.002	34	19	3	1
Overall maximum (Whitecourt)		0.7	0.051	4.3	2.5	2.5	0.046	0.112	0.026	0.137	0.012	0.005	0.003	946	441	32	113
Fort Assiniboine (8)	Site # 9 (4)	0.3	0.039	2.7	2.2	0.6	0.001	0.018	0.008	0.023	0.004	0.001	0.000	17	13	2	10
	Site # 10 (4)	0.2	0.041	2.4	2.1	0.4	0.002	0.005	0.005	0.011	0.002	0.001	0.000	30	15	2	1
Swan Hills (8)	Site # 11 (8)	0.5	0.045	3.0	2.0	1.3	0.002	0.007	0.012	0.019	0.009	0.001	0.000	397	298	19	7
Kinuso (8)	Site # 12 (8)	0.6	0.042	2.5	2.1	0.5	0.001	0.010	0.005	0.011	0.008	0.001	0.000	576	330	27	3
Overall maximum (Swan Hills area)		0.6	0.045	3.0	2.2	1.3	0.002	0.018	0.012	0.023	0.009	0.001	0.000	576	330	27	10
Shiningbank Lake Area (19)	Site # 13 (19)	0.6	0.054	3.3	2.5	1.3	0.003	0.060	0.030	0.066	0.013	0.001	0.001	387	279	43	4
Overall maximum (Shiningbank)		0.6	0.054	3.3	2.5	1.3	0.003	0.060	0.030	0.066	0.013	0.001	0.001	387	279	43	4
Overall maximum		**0.7**	**0.054**	**4.3**	**2.5**	**2.5**	**0.046**	**0.112**	**0.030**	**0.137**	**0.013**	**0.005**	**0.003**	**946**	**441**	**43**	**113**
One-Hour Guideline		**13.0**	**0.082**		**n/a**		**0.170**	**n/a**	**0.210**	**n/a**	**2.0**	**n/a**	**0.010**		**n/a**		**n/a**

Table A3: Median one-hour air quality parameter concentrations in Alberta*

Air Quality Station	Station or Survey Type	Monitoring Period	CO ppm	O_3 ppm	THC ppm	CH_4 ppm	RHC ppm	SO_2 ppm	NO_2 ppm	NH_3 ppm	TRS ppm	H_2S ppm	TSP $\mu g/m^3$	PM_{10} $\mu g/m^3$	$PM_{2.5}$ $\mu g/m^3$	PAHs ng/m^3
Whitecourt/Swan Hills/Shiningbank Lake[1]	mobile survey	Nov. 2000 to June 2001	0.2	0.027	2.3	2.0	0.3	0.004	0.005	0.001	0.001	0.000	47	29	4	1
Bow Corridor[1]	mobile survey	Dec. 1999 to Sep. 2000	0.2	0.030	1.9	1.8	0.1	0.001	0.007	0.001	0.001	0.000	74	40	4	4
County of Grande Prairie[1]	mobile survey	Dec. 1998 to Oct. 1999	0.2	0.036	2.0	1.7	0.2	0.001	0.002	0.001	0.000	0.000	14	9	2	2
Caroline/Sundre area[1]	mobile survey	Apr. 1997 to Apr. 1998	0.3	0.042	2.1	1.8	0.2	0.002	0.009	n/a	0.000	0.000	4	3	1	n/a
City of Lethbridge[1]	mobile survey	Sep. 1998 to Jul. 1999	0.2	0.046	1.9	1.6	0.2	0.000	0.003	0.005	0.000	0.001	17	11	2	3
City of Medicine Hat[1]	mobile survey	May 1998 to Jan. 1999	0.4	0.031	2.1	1.8	0.2	0.001	0.009	0.003	0.000	0.000	16	11	2	5
Lethbridge area (Picture Butte, Sterling)[1]	mobile survey	Sep. 1998 to Jul. 1999	0.2	0.044	2.1	1.8	0.2	0.001	0.002	0.075	0.002	0.001	42	24	3	2
Beaverlodge[2]	rural	Jan. to Dec. 2001	n/a	0.027	n/a	n/a	n/a	0.000	0.002	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Calgary Central[2]	urban	Jan. to Dec. 2001	0.5	0.014	2.0	n/a	n/a	n/a	0.025	n/a	n/a	n/a	n/a	19	8	n/a
Calgary East[2]	urban	Jan. to Dec. 2001	0.5	0.015	2.1	n/a	n/a	0.002	0.022	n/a	n/a	0.001	n/a	n/a	n/a	n/a
Calgary Northwest[2]	urban	Jan. to Dec. 2001	0.3	0.024	2.0	n/a	n/a	n/a	0.013	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Edmonton Central[2]	urban	Jan. to Dec. 2001	0.5	0.014	2.0	n/a	n/a	n/a	0.023	n/a	n/a	n/a	n/a	n/a	7	n/a
Edmonton East[2]	urban	Jan. to Dec. 2001	0.3	0.021	2.2	n/a	n/a	0.002	0.015	n/a	n/a	0.000	n/a	n/a	8	n/a
Edmonton Northwest[2]	urban	Jan. to Dec. 2001	0.5	0.016	2.2	n/a	n/a	n/a	0.020	n/a	n/a	n/a	n/a	19	10	n/a
Fort Saskatchewan[2]	small urban	Jan. to Dec. 2001	0.3	0.021	1.9	n/a	n/a	0.001	0.009	0.002	n/a	0.000	n/a	n/a	n/a	n/a
Red Deer[2]	small urban	Jan. to Dec. 2001	0.3	0.019	2.1	n/a	n/a	0.000	0.010	n/a	n/a	0.000	n/a	n/a	7	n/a
Buffalo Viewpoint[3]	industrial	Jan. to Dec. 2001	n/a	n/a	1.9	n/a	n/a	0.000	n/a	n/a	n/a	0.000	n/a	n/a	n/a	n/a
Fort Chipewyan[3]	rural	Jan. to Dec. 2001	n/a	0.029	n/a	n/a	n/a	0.000	0.000	n/a	n/a	n/a	n/a	n/a	4	n/a
Fort McKay[3]	rural	Jan. to Dec. 2001	n/a	0.020	1.8	n/a	n/a	0.000	0.003	n/a	0.000	n/a	n/a	n/a	5	n/a
Fort McMurray (Athabasca Valley)[3]	small urban	Jan. to Dec. 2001	0.2	0.016	1.9	n/a	n/a	0.000	0.007	n/a	0.000	n/a	n/a	n/a	5	n/a
Fort McMurray (Patricia McInnes)[3]	small urban	Jan. to Dec. 2001	n/a	0.021	1.9	n/a	n/a	0.000	0.003	n/a	0.000	n/a	n/a	n/a	6	n/a
Mannix[3]	industrial	Jan. to Dec. 2001	n/a	n/a	1.8	n/a	n/a	0.001	n/a	n/a	n/a	0.000	n/a	n/a	n/a	n/a
Mildred Lake[3]	industrial	Jan. to Dec. 2001	n/a	n/a	2.0	n/a	n/a	0.001	n/a	n/a	n/a	0.000	n/a	n/a	n/a	n/a
Carrot Creek[4]	rural	Jan. to Sept. 2001	n/a	0.034	n/a	n/a	n/a	0.001	0.004	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hightower Ridge[4]	background	Jan. to Sept. 2001	n/a	0.048	n/a	n/a	n/a	0.000	0.000	n/a	n/a	n/a	n/a	5	1	n/a
Steeper[4]	rural	Jan. to Sept. 2001	n/a	0.043	n/a	n/a	n/a	0.000	0.001	n/a	n/a	n/a	n/a	7	n/a	n/a
Tomahawk[4]	rural	Jan. to Sept. 2001	n/a	0.034	n/a	n/a	n/a	0.001	0.003	n/a	n/a	n/a	n/a	11	2	n/a
Violet Grove[4]	rural	Jan. to Sept. 2001	n/a	0.037	1.8	n/a	n/a	0.001	0.002	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sherwood Park[5]	small urban	Jan. to Dec. 2001	n/a	n/a	2.2	n/a	n/a	0.002	n/a	n/a	n/a	0.000	n/a	n/a	n/a	n/a
Caroline[6]	rural	Aug. to Dec. 2001	n/a	0.035	2.0	1.9	n/a	0.001	0.002	n/a	0.000	0.000	n/a	n/a	n/a	n/a

1 Mobile survey conducted by Alberta Environment.
2 Station operated by Alberta Environment.
3 Station operated by the Wood Buffalo Environmental Association
4 Station operated by the West Central Airshed Society (data from Oct to Dec 2001 not available).
5 Station operated by the Strathcona Industrial Association.
6 Station operated by the Parkland Airshed Management Association.
n/a Parameter not monitored or data not available.
* Data is from the Alberta Ambient Air Data Management System (http://www.casadata.org).

Table A4: Maximum one-hour air quality parameter concentrations in Alberta*

Air Quality Station	Station or Survey Type	Monitoring Period	CO	O_3	THC	CH_4	RHC	SO_2	NO_2	NH_3	TRS	H_2S	TSP	PM_{10}	$PM_{2.5}$	PAHs
			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	ng/m^3
Whitecourt/Swan Hills/Shiningbank Lake[1]	mobile survey	Nov. 2000 to June 2001	0.7	0.054	4.3	2.5	2.5	0.046	0.030	0.013	0.005	0.003	946	441	43	113
Bow Corridor[1]	mobile survey	Dec. 1999 to Sep. 2000	1.1	0.056	7.8	2.2	6.6	0.092	0.031	0.034	0.004	0.002	2082	1094	60	36
County of Grande Prairie[1]	mobile survey	Dec. 1998 to Oct. 1999	1.0	0.064	32.4	6.4	29.4	0.043	0.061	0.030	0.010	0.009	2305	1287	101	35
Caroline/Sundre area[1]	mobile survey	Apr. 1997 to Apr. 1998	0.9	0.059	2.9	2.6	0.7	0.043	0.040	n/a	0.008	0.008	52	43	17	n/a
City of Lethbridge[1]	mobile survey	Sep. 1998 to Jul. 1999	2.4	0.062	2.2	1.9	0.4	0.007	0.016	0.020	0.001	0.003	405	363	294	21
City of Medicine Hat[1]	mobile survey	May 1998 to Jan. 1999	2.8	0.062	2.6	2.3	0.4	0.029	0.080	0.027	0.001	0.004	213	135	12	35
Lethbridge area (Picture Butte, Sterling)[1]	mobile survey	Sep. 1998 to Jul. 1999	1.2	0.059	9.5	7.1	1.6	0.004	0.013	1.364	0.054	0.054	490	298	32	11
Beaverlodge[2]	rural	Jan. to Dec. 2001	n/a	0.068	n/a	n/a	n/a	0.030	0.028	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Calgary Central[2]	urban	Jan. to Dec. 2001	9.7	0.061	4.1	n/a	n/a	n/a	0.150	n/a	n/a	n/a	n/a	262	60	n/a
Calgary East[2]	urban	Jan. to Dec. 2001	10.1	0.068	5.1	n/a	n/a	0.036	0.092	n/a	n/a	0.038	n/a	n/a	n/a	n/a
Calgary Northwest[2]	urban	Jan. to Dec. 2001	6.3	0.073	3.5	n/a	n/a	n/a	0.065	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Edmonton Central[2]	urban	Jan. to Dec. 2001	5.4	0.062	4.8	n/a	n/a	n/a	0.086	n/a	n/a	n/a	n/a	n/a	275	n/a
Edmonton East[2]	urban	Jan. to Dec. 2001	2.8	0.083	25.0	n/a	n/a	0.061	0.084	n/a	n/a	0.022	n/a	n/a	276	n/a
Edmonton Northwest[2]	urban	Jan. to Dec. 2001	11.2	0.071	6.5	n/a	n/a	n/a	0.104	n/a	n/a	n/a	n/a	391	261	n/a
Fort Saskatchewan[2]	small urban	Jan. to Dec. 2001	5.1	0.080	5.5	n/a	n/a	0.022	0.077	0.041	n/a	0.005	n/a	n/a	83	n/a
Red Deer[2]	small urban	Jan. to Dec. 2001	5.0	0.073	6.4	n/a	n/a	0.011	0.051	n/a	n/a	0.009	n/a	n/a	162	n/a
Buffalo Viewpoint[3]	industrial	Jan. to Dec. 2001	n/a	n/a	11.8	n/a	n/a	0.231	n/a	n/a	n/a	0.012	n/a	n/a	n/a	n/a
Fort Chipewyan[3]	rural	Jan. to Dec. 2001	n/a	0.055	n/a	n/a	n/a	0.025	0.024	n/a	n/a	n/a	n/a	n/a	58	n/a
Fort McKay[3]	rural	Jan. to Dec. 2001	n/a	0.058	4.2	n/a	n/a	0.158	0.042	n/a	0.018	n/a	n/a	n/a	86	n/a
Fort McMurray (Athabasca Valley)[3]	small urban	Jan. to Dec. 2001	5.8	0.062	5.8	n/a	n/a	0.071	0.062	n/a	0.003	n/a	n/a	n/a	267	n/a
Fort McMurray (Patricia McInnes)[3]	small urban	Jan. to Dec. 2001	n/a	0.074	6.3	n/a	n/a	0.042	0.073	n/a	0.011	n/a	n/a	n/a	101	n/a
Mannix[3]	industrial	Jan. to Dec. 2001	n/a	n/a	6.6	n/a	n/a	0.211	n/a	n/a	n/a	0.027	n/a	n/a	n/a	n/a
Mildred Lake[3]	industrial	Jan. to Dec. 2001	n/a	n/a	6.9	n/a	n/a	0.136	n/a	n/a	n/a	0.022	n/a	n/a	n/a	n/a
Carrot Creek[4]	rural	Jan. to Sept. 2001	n/a	0.077	n/a	n/a	n/a	0.019	0.059	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hightower Ridge[4]	background	Jan. to Sept. 2001	n/a	0.081	n/a	n/a	n/a	0.018	0.015	n/a	n/a	n/a	n/a	31	36	n/a
Steeper[4]	rural	Jan. to Sept. 2001	n/a	0.075	n/a	n/a	n/a	0.006	0.019	n/a	n/a	n/a	n/a	193	n/a	n/a
Tomahawk[4]	rural	Jan. to Sept. 2001	n/a	0.080	n/a	n/a	n/a	0.029	0.039	n/a	n/a	n/a	n/a	187	56	n/a
Violet Grove[4]	rural	Jan. to Sept. 2001	n/a	0.070	8.4	n/a	n/a	0.015	0.036	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sherwood Park[5]	small urban	Jan. to Dec. 2001	n/a	n/a	8.8	n/a	n/a	0.043	n/a	n/a	n/a	0.012	n/a	n/a	n/a	n/a
Caroline[6]	rural	Jan. to Dec. 2001	n/a	0.074	7.2	3.5	n/a	0.017	0.031	n/a	0.017	0.017	n/a	n/a	n/a	n/a

1 Mobile survey conducted by Alberta Environment.
2 Station operated by Alberta Environment.
3 Station operated by the Wood Buffalo Environmental Association
4 Station operated by the West Central Airshed Society (data from Oct to Dec 2001 not available).
5 Station operated by the Strathcona Industrial Association.
6 Station operated by the Parkland Airshed Management Association.
n/a Parameter not monitored or data not available.
* Data is from the Alberta Ambient Air Data Management System (http://www.casadata.org).

Table A5: One-hour average air pollutant concentrations in Whitecourt-Swan Hills area survey (November 20 to 24, 2000).

Area	Date	Monitoring Location	Time (MST)	CO	O_3	THC	CH_4	RHC	SO_2	NO	NO_2	NO_x	NH_3	TRS	H_2S	TSP	PM_{10}	$PM_{2.5}$	PAH
				ppm	ppm	ppm			ppm	ppm			ppm	ppm	ppm	$\mu g/m^3$			ng/m^3
Shiningbank Lake	20-Nov-00	Site # 13	(11:22 a.m. to 12:22 p.m.)	0.3	0.012	3.0	2.5	0.6	0.001	0.012	0.008	0.019	0.003	0.000	0.000	28	20	4	1
			(12:25 p.m. to 1:30 p.m.)	0.3	0.017	2.7	2.2	0.5	0.001	0.012	0.008	0.018	0.004	0.000	0.000	79	50	9	4
Whitecourt Area	20-Nov-00	Site # 6	(3:36 p.m. to 4:37 p.m.)	0.6	0.027	2.3	2.0	0.4	0.019	0.007	0.011	0.015	0.012	0.003	0.001	34	22	3	2
		Site # 7	(6:31 p.m. to 7:32 p.m.)	0.2	0.004	2.3	2.1	0.2	0.002	0.065	0.013	0.075	0.010	0.001	0.001	113	81	9	22
Whitecourt Area	21-Nov-00	Site # 1	(8:28 a.m. to 9:28 a.m.)	0.1	0.004	2.7	2.1	0.5	0.003	0.028	0.020	0.046	0.003	0.003	0.000	31	23	5	8
		Site # 2	(9:40 a.m. to 10:40 a.m.)	0.0	0.003	2.6	2.2	0.4	0.002	0.028	0.014	0.042	0.001	0.002	0.000	164	85	8	20
		Site # 3	(10:49 a.m. to 11:49 a.m.)	0.2	0.007	2.7	2.2	0.5	0.002	0.043	0.018	0.061	0.001	0.001	0.000	570	299	24	30
		Site # 4	(12:07 p.m. to 1:04 p.m.)	0.0	0.012	2.4	2.0	0.3	0.005	0.025	0.015	0.039	0.004	0.001	0.000	946	441	31	12
		Site # 7	(1:10 p.m. to 2:10 p.m.)	0.0	no data	2.7	2.0	0.8	0.005	0.014	0.009	0.022	0.002	0.001	0.000	270	142	13	4
		Site # 5	(2:35 p.m. to 3:36 p.m.)	0.0	0.021	2.3	2.0	0.3	0.013	0.003	0.006	0.009	0.000	0.001	0.000	24	18	3	2
		Site # 1	(3:52 p.m. to 4:53 p.m.)	0.4	0.002	2.5	1.9	0.6	0.006	0.046	0.026	0.073	0.002	0.001	0.001	78	49	7	26
		Site # 2	(4:58 p.m. to 5:58 p.m.)	*0.8*	*0.001*	*2.6*	*2.0*	*0.6*	0.003	*0.045*	*0.023*	*0.068*	*0.002*	0.002	0.001	*135*	*81*	9	*24*
		Site # 3	(6:15 p.m. to 7:15 p.m.)	0.7	0.001	3.0	2.3	0.8	0.002	0.103	0.022	0.126	0.003	0.001	0.001	671	388	32	60
		Site # 4	(7:22 p.m. to 8:22 p.m.)	0.6	0.001	4.3	2.2	2.5	0.004	0.112	0.026	0.137	0.006	0.003	0.001	213	122	9	50
Swan Hills Area	22-Nov-00	Site # 9	(8:41 a.m. to 9:48 a.m.)	0.3	0.003	2.4	2.2	0.2	0.001	0.018	0.005	0.023	0.001	0.000	0.000	9	7	2	10
		Site # 10	(9:58 a.m. to 10:57 a.m.)	0.2	0.013	2.3	2.1	0.2	0.002	0.005	0.005	0.011	0.001	0.000	0.000	10	8	2	1
		Site # 12	(12:43 p.m. to 1:42 p.m.)	0.6	0.020	2.3	2.1	0.3	0.001	0.006	0.005	0.011	0.006	0.000	0.000	12	7	4	3
			(1:43 p.m. to 2:47 p.m.)	0.5	0.023	2.3	2.0	0.3	0.001	0.010	0.004	0.010	0.008	0.000	0.000	23	9	2	3
		Site # 11	(3:42 p.m. to 4:41 p.m.)	0.2	0.027	2.1	1.6	0.6	0.002	0.007	0.012	0.019	0.009	0.001	0.000	20	13	2	7
			(4:42 p.m. to 5:41 p.m.)	0.2	0.032	2.0	1.6	0.4	0.002	0.004	0.007	0.010	0.006	0.001	0.000	5	4	2	3
Whitecourt Area	23-Nov-00	Site # 4	(8:04 a.m. to 9:04 a.m.)	0.1	0.000	2.9	2.3	0.7	0.001	0.066	0.014	0.080	0.005	0.001	0.001	162	93	8	40
		Site # 3	(9:20 a.m. to 10:19 a.m.)	0.2	0.001	2.9	2.2	0.7	0.002	0.057	0.015	0.072	0.004	0.001	0.000	422	225	19	113
		Site # 2	(10:31 a.m. to 11:32 a.m.)	0.1	0.004	2.7	2.1	0.7	0.002	0.048	0.016	0.063	0.004	0.001	0.000	303	133	10	19
		Site # 1	(11:38 a.m. to 12:37 p.m.)	0.1	0.008	2.4	2.0	0.5	0.002	0.028	0.017	0.044	0.005	0.001	0.000	97	54	6	8
		Site # 5	(12:50 p.m. to 1:51 p.m.)	0.0	0.020	2.5	2.1	0.5	0.002	0.008	0.010	0.017	0.003	0.001	0.000	53	32	4	8
		Site # 4	(2:43 p.m. to 3:42 p.m.)	*0.7*	*0.000*	*2.8*	*2.0*	*0.8*	0.005	*0.104*	*0.027*	*0.131*	*0.004*	0.001	0.001	*2009*	*1101*	*73*	*70*
		Site # 3	(3:51 p.m. to 4:59 p.m.)	*0.6*	*0.001*	*3.3*	*2.4*	*1.1*	0.003	*0.096*	*0.025*	*0.120*	*0.004*	0.001	0.001	*925*	*565*	*50*	*68*
		Site # 2	(5:04 p.m. to 6:04 p.m.)	*2.2*	*0.003*	*3.5*	*2.2*	*1.6*	0.003	*0.183*	*0.022*	*0.204*	*0.008*	0.001	0.001	*206*	*140*	*20*	*72*
		Site # 1	(6:24 p.m. to 7:24 p.m.)	*0.7*	*0.001*	*2.5*	*1.9*	*0.6*	0.005	*0.106*	*0.031*	*0.135*	*0.004*	0.002	0.001	*27*	*20*	*4*	*60*
Whitecourt Area	24-Nov-00	Site # 6	(9:17 a.m. to 10:17 a.m.)	0.1	0.032	2.5	2.0	0.5	0.046	0.008	0.009	0.015	0.010	0.005	0.003	20	11	1	3
		Site # 8	(10:45 a.m. to 11:45 a.m.)	0.1	0.021	2.4	1.9	0.5	0.002	0.006	0.003	0.009	0.003	0.002	0.002	6	3	0	1
		Site # 7	(11:59 a.m. to 12:58 p.m.)	0.1	0.019	2.5	1.9	0.6	0.002	0.013	0.013	0.027	0.001	0.000	0.000	150	81	7	3
Shiningbank Lake	24-Nov-00	Site # 13	(1:28 p.m. to 2:27 p.m.)	0.1	0.037	2.1	1.7	0.5	0.000	0.003	0.001	0.002	0.001	0.000	0.000	82	50	6	0
			(2:28 p.m. to 3:28 p.m.)	0.1	0.036	2.2	1.8	0.5	0.003	0.001	0.003	0.004	0.003	0.000	0.000	60	29	3	0
			(3:28 p.m. to 4:28 p.m.)	0.2	0.022	3.3	2.1	1.3	0.001	0.060	0.030	0.086	0.009	0.000	0.001	**23**	**13**	2	1
one-hour guideline				**13.0**	**0.082**	**n/a**	**n/a**	**n/a**	**0.172**	**n/a**	**0.212**	**n/a**	**2.0**	**n/a**	**0.010**	**n/a**	**n/a**	**n/a**	**n/a**

data in italics - indicates less than 75% of data available for one hour period due to interference from MAML generator exhaust or instrument malfunction

no data - indicates that the analyzer was not operational for this time period

n/a - no one hour guideline

ppm - parts per million.

ng/m^3 - nanograms per cubic metre of air.

$\mu g/m^3$ micrograms per cubic metre of air.

List of Air Quality Parameters

CO - carbon monoxide
O_3 - ozone
THC - total hydrocarbons
CH_4 - methane
RHC - reactive hydrocarbons
SO_2 - sulphur dioxide
NO_x - total oxides of nitrogen
NO_2 - nitrogen dioxide
NO - nitric oxide
NH_3 - ammonia
TRS - total reduced sulphur
H_2S - hydrogen sulphide
PAH - polycyclic aromatic hydrocarbons
TSP - total suspended particulates
PM_{10} - inhalable particulates
$PM_{2.5}$ - respirable particulates

Table A6: One-hour average air pollutant concentrations in Whitecourt/Swan Hills area survey (February 20 to 22, and March 1 and 2, 2001).

Area	Date	Monitoring Location	Time (MST)	CO	O_3	THC	CH_4	RHC	SO_2	NO	NO_2	NO_X	NH_3	TRS	H_2S	TSP	PM_{10}	$PM_{2.5}$	PAH
				ppm	ppm	ppm			ppm	ppm			ppm	ppm	ppm	$\mu g/m^3$			ng/m^3
Shiningbank Lake	20-Feb-01	Site # 13	(11:25 a.m. to 12:24 p.m.)	0.2	0.025	2.8	2.2	0.7	.001	.005	.007	.012	.001	.001	.000	49	33	5	1
			(12:25 p.m. to 1:24 p.m.)	0.2	0.033	2.6	2.1	0.5	.002	.004	.005	.007	.004	.001	.000	116	73	11	1
			(1:26 p.m. to 2:25 p.m.)	0.3	0.032	2.7	2.1	0.6	.002	.003	.005	.008	.003	.001	.000	58	32	4	1
Whitecourt Area	20-Feb-01	Site # 6	(4:04 p.m. to 5:03 p.m.)	0.2	0.030	2.7	2.1	0.6	.019	.002	.007	.009	.005	.003	.002	31	18	3	1
		Site # 5	(6:12 p.m. to 7:12 p.m.)	0.2	0.026	2.5	2.0	0.5	.004	.001	.011	.011	.005	.001	.001	289	185	18	1
Swan Hills Area	21-Feb-01	Site # 9	(9:11 a.m. to 10:13 a.m.)	0.3	0.016	2.7	2.2	0.6	.000	.007	.008	.015	.004	.001	.000	17	13	2	1
		Site # 10	(11:46 a.m. to 12:45 p.m.)	0.2	0.037	2.4	2.0	0.4	.000	.002	.001	.002	.002	.001	.000	15	10	2	0
		Site # 12	(2:17 p.m. to 3:16 p.m.)	0.1	0.035	2.5	2.0	0.5	.000	.001	.001	.002	.001	.001	.000	7	5	1	0
			(3:17 p.m. to 4:17 p.m.)	0.1	0.037	2.5	2.0	0.5	.000	.002	.004	.006	.002	.001	.000	6	4	1	2
		Site # 11	(5:49 p.m. to 6:48 p.m.)	0.1	0.036	2.4	1.9	0.5	.000	.000	.003	.003	.000	.000	.000	10	7	1	1
			(6:49 p.m. to 7:47 p.m.)	0.1	0.035	2.3	1.9	0.4	.000	.000	.002	.002	.000	.000	.000	7	5	1	0
Whitecourt Area	22-Feb-01	Site # 6	(9:33 a.m. to 10:32 a.m.)	0.3	0.025	2.9	2.3	0.6	.045	.008	.008	.015	.003	.002	.001	17	9	2	0
		Site # 7	(11:47 a.m. to 12:47 p.m.)	0.1	0.025	2.7	2.2	0.5	.001	.008	.006	.014	.005	.001	.001	50	32	5	1
		Site # 5	(1:10 p.m. to 2:10 p.m.)	0.1	0.029	2.7	2.2	0.5	.002	.003	.005	.009	.005	.001	.000	494	269	22	1
Shiningbank Lake	22-Feb-01	Site # 13	(3:12 p.m. to 4:12 p.m.)	0.1	0.031	2.8	2.2	0.6	.002	.007	.007	.013	.004	.001	.000	387	279	43	2
			(4:13 p.m. to 5:17 p.m.)	0.0	0.029	2.8	2.2	0.6	.002	.002	.008	.010	.004	.001	.000	259	187	25	2
Whitecourt Area	01-Mar-01	Site # 1	(8:40 a.m. to 9:40 a.m.)	0.4	0.035	2.5	1.9	0.5	0.005	0.003	0.008	0.011	0.002	0.003	0.000	58	36	7	5
		Site # 2	(9:47 a.m. to 10:46 a.m.)	0.3	0.037	2.4	1.9	0.4	0.006	0.002	0.003	0.005	0.001	0.003	0.000	15	9	2	2
		Site # 3	(10:52 a.m. to 11:50 a.m.)	0.5	0.032	2.5	2.0	0.4	0.006	0.007	0.008	0.015	0.002	0.003	0.000	131	54	6	10
		Site # 4	(11:57 a.m. to 12:56 p.m.)	0.3	0.039	2.4	1.9	0.4	0.007	0.002	0.002	0.003	0.001	0.002	0.000	13	7	1	2
		Site # 8	(1:09 p.m. to 2:08 p.m.)	0.3	0.038	2.5	1.9	0.5	0.007	0.003	0.004	0.006	0.002	0.004	0.000	34	19	2	0
		Site # 7	(2:22 p.m. to 3:22 p.m.)	0.5	0.032	2.6	1.9	0.5	0.005	0.010	0.011	0.021	0.002	0.002	0.000	50	31	4	6
		Site # 1	(3:45 p.m. to 4:45 p.m.)	*0.3*	*0.040*	*2.6*	*1.9*	*0.5*	0.005	*0.001*	*0.004*	*0.005*	*0.011*	0.002	0.000	*12*	*7*	*1*	*1*
		Site # 2	(5:10 p.m. to 6:09 p.m.)	0.3	0.028	2.5	1.9	0.5	0.009	0.010	0.012	0.022	0.002	0.002	0.000	252	157	15	6
		Site # 3	(6:15 p.m. to 7:14 p.m.)	0.3	0.031	2.6	1.9	0.5	0.006	0.000	0.007	0.007	0.002	0.002	0.000	74	44	5	2
		Site # 4	(7:21 p.m. to 8:21 p.m.)	0.4	0.016	2.6	2.0	0.6	0.006	0.001	0.017	0.019	0.001	0.002	0.000	98	42	5	2
Whitecourt Area	02-Mar-01	Site # 1	(7:33 a.m. to 8:33 a.m.)	0.5	0.012	2.9	2.3	0.8	0.001	0.003	0.013	0.017	0.001	0.001	0.000	44	28	5	3
		Site # 2	(8:40 a.m. to 9:40 a.m.)	0.6	0.013	2.6	2.1	0.6	0.002	0.011	0.014	0.026	0.000	0.001	0.001	269	148	13	5
		Site # 3	(9:46 a.m. to 10:46 a.m.)	0.3	0.022	2.5	2.0	0.6	0.002	0.006	0.009	0.016	0.000	0.001	0.000	74	40	4	3
		Site # 4	(11:07 a.m. to 12:07 p.m.)	0.3	0.026	2.5	2.0	0.6	0.003	0.003	0.007	0.012	0.000	0.002	0.001	66	35	4	2
		Site # 8	(12:23 p.m. to 1:22 p.m.)	0.2	0.029	2.4	2.0	0.6	0.004	0.004	0.008	0.015	0.000	0.002	0.001	30	16	2	1
		Site # 1	(1:44 p.m. to 2:43 p.m.)	0.5	0.037	2.4	1.9	0.6	0.003	0.005	0.005	0.010	0.000	0.002	0.000	101	63	7	6
		Site # 2	(2:50 p.m. to 3:49 p.m.)	0.3	0.040	2.4	1.9	0.6	0.003	0.000	0.001	0.002	0.000	0.003	0.001	12	8	1	0
		Site # 3	(3:57 p.m. to 4:55 p.m.)	0.3	0.032	2.4	1.9	0.5	0.003	0.001	0.005	0.008	0.000	0.002	0.001	37	15	2	2
		Site # 4	(5:02 p.m. to 6:01 p.m.)	0.2	0.040	2.4	1.9	0.5	0.003	0.000	0.000	0.001	0.000	0.002	0.001	6	4	1	0
one-hour guideline				**13.0**	**0.082**	**n/a**	**n/a**	**n/a**	**0.172**	**n/a**	**0.212**	**n/a**	**2.0**	**n/a**	**0.010**	**n/a**	**n/a**	**n/a**	**n/a**

data in italics - indicates less than 75% of data available for one hour period due to interference from MAML generator exhaust or instrument malfunction

no data - indicates that the analyzer was not operational for this time period

n/a - no one hour guideline

ppm - parts per million.

ng/m^3 - nanograms per cubic metre of air.

$\mu g/m^3$ micrograms per cubic metre of air.

List of Air Quality Parameters

CO - carbon monoxide
O_3 - ozone
THC - total hydrocarbons
CH_4 - methane
RHC - reactive hydrocarbons
SO_2 - sulphur dioxide
NO_X - total oxides of nitrogen
NO_2 - nitrogen dioxide
NO - nitric oxide
NH_3 - ammonia
TRS - total reduced sulphur
H_2S - hydrogen sulphide
PAH - polycyclic aromatic hydrocarbons
TSP - total suspended particulates
PM_{10} - inhalable particulates
$PM_{2.5}$ - respirable particulates

Table A7: One-hour average air pollutant concentrations in Whitecourt/Swan Hills area survey (May 7 to 11, 2001).

Area	Date	Monitoring Location	Time (MST)	CO	O_3	THC	CH_4	RHC	SO_2	NO	NO_2	NO_x	NH_3	TRS	H_2S	TSP	PM_{10}	$PM_{2.5}$	PAH
				ppm	ppm	ppm			ppm		ppm		ppm	ppm	ppm	$\mu g/m^3$			ng/m^3
Shiningbank Lake	07-May-01	Site # 13	(1:28 p.m. to 2:27 p.m.)	0.3	0.054	1.6	1.6	0.1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	47	32	6	0
			(3:00 p.m. to 4:00 p.m.)	0.6	0.047	2.0	1.8	0.3	0.002	0.020	0.023	0.040	0.013	0.001	0.000	44	23	4	0
Whitecourt Area	07-May-01	Site # 5	(5:23 p.m. to 6:25 p.m.)	0.3	0.051	1.9	1.7	0.2	0.012	0.004	0.008	0.011	0.001	0.000	0.000	585	308	25	1
	08-May-01	Site # 1	(7:08 a.m. to 8:08 a.m.)	0.1	0.028	2.1	2.0	0.1	0.002	0.004	0.006	0.012	0.004	0.001	0.000	98	61	7	4
		Site # 2	(8:17 a.m. to 9:20 a.m.)	0.0	0.039	2.1	2.1	0.0	0.002	0.002	0.002	0.004	0.003	0.001	0.000	41	23	3	0
		Site # 3	(9:26 a.m. to 10:26 a.m.)	0.0	0.036	2.4	2.1	0.4	0.002	0.006	0.007	0.013	0.002	0.001	0.000	355	176	14	4
		Site # 3	(10:26 a.m. to 11:26 a.m.)	0.0	0.037	2.5	2.1	0.5	0.002	0.006	0.004	0.010	0.001	0.001	0.000	696	338	28	2
		Site # 4	(11:41 a.m. to 12:39 p.m.)	0.0	0.044	2.2	2.1	0.2	0.001	0.002	0.002	0.004	0.001	0.001	0.000	33	18	2	1
		Site # 8	(2:00 p.m. to 3:00 p.m.)	0.1	0.042	2.1	2.1	0.1	0.001	0.003	0.002	0.006	0.003	0.001	0.000	7	4	1	0
		Site # 4	(3:20 p.m. to 4:20 p.m.)	0.1	0.048	2.2	2.1	0.1	0.001	0.003	0.004	0.008	0.000	0.000	0.000	231	140	15	2
		Site # 7	(4:27 p.m. to 5:26 p.m.)	0.1	0.050	2.2	2.1	0.2	0.000	0.004	0.006	0.011	0.001	0.000	0.000	85	53	8	1
		Site # 2	(5:50 p.m. to 6:50 p.m.)	0.2	0.051	2.1	2.0	0.1	0.001	0.000	0.000	0.002	0.001	0.001	0.000	45	27	3	0
		Site # 1	(7:00 p.m. to 8:00 p.m.)	0.2	0.045	1.9	1.8	0.1	0.000	0.001	0.005	0.006	0.000	0.000	0.000	95	56	6	1
Swan Hills Area	09-May-01	Site # 9	(8:03 a.m. to 9:03 a.m.)	0.3	0.039	2.1	2.1	0.1	0.000	0.001	0.001	0.001	0.001	0.001	0.000	12	7	1	0
		Site # 10	(9:14 a.m. to 10:12 a.m.)	0.2	0.041	2.0	1.9	0.1	0.001	0.000	0.001	0.000	0.000	0.001	0.000	30	15	2	0
		Site # 12	(12:07 p.m. to 1:06 p.m.)	0.1	0.041	2.0	1.9	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.000	576	330	27	1
			(1:07 p.m. to 2:07 p.m.)	0.1	0.042	2.0	1.8	0.1	0.001	0.001	0.000	0.001	0.001	0.001	0.000	275	161	14	1
		Site # 11	(3:05 p.m. to 4:04 p.m.)	0.4	0.045	3.0	1.9	1.3	0.001	0.001	0.000	0.002	0.000	0.001	0.000	11	6	1	1
			(4:05 p.m. to 5:04 p.m.)	0.5	0.045	2.0	1.9	0.1	0.000	0.000	0.001	0.002	0.000	0.000	0.000	9	6	1	0
Whitecourt Area	10-May-01	Site # 1	(7:03 a.m. to 8:03 a.m.)	0.5	0.023	2.2	2.0	0.3	0.002	0.008	0.011	0.019	0.001	0.000	0.000	188	120	13	5
		Site # 2	(8:09 a.m. to 9:09 a.m.)	0.3	0.032	2.2	2.0	0.1	0.002	0.004	0.005	0.007	0.000	0.000	0.000	71	37	4	1
		Site # 3	(9:20 a.m. to 10:20 a.m.)	0.3	0.041	2.4	1.9	0.5	0.002	0.003	0.003	0.005	0.000	0.001	0.000	99	59	6	1
		Site # 4	(10:43 a.m. to 11:43 a.m.)	0.2	0.044	2.0	1.9	0.1	0.001	0.002	0.003	0.004	0.001	0.001	0.000	152	96	11	1
		Site # 8	(11:55 a.m. to 12:55 p.m.)	0.3	0.045	1.9	1.8	0.1	0.000	0.002	0.001	0.002	0.001	0.000	0.001	18	13	3	0
		Site # 7	(1:23 p.m. to 2:23 p.m.)	0.0	0.045	2.3	2.2	0.1	0.001	0.004	0.007	0.010	0.001	0.000	0.000	53	37	6	4
		Site # 4	(2:28 p.m. to 3:28 p.m.)	0.2	0.047	2.3	2.2	0.1	0.001	0.001	0.002	0.000	0.000	0.000	0.000	77	50	7	1
		Site # 3	(3:33 p.m. to 4:32 p.m.)	0.2	0.041	2.4	2.1	0.3	0.001	0.001	0.003	0.005	0.000	0.002	0.000	106	56	6	1
		Site # 2	(4:41 p.m. to 5:40 p.m.)	0.2	0.045	2.3	2.2	0.1	0.001	0.002	0.003	0.004	0.001	0.001	0.000	101	62	7	1
		Site # 1	(5:46 p.m. to 6:45 p.m.)	0.2	0.045	2.1	2.1	0.1	0.002	0.000	0.002	0.002	0.000	0.001	0.000	74	48	6	1
Shiningbank Lake	11-May-01	Site # 13	(7:16 a.m. to 8:16 a.m.)	0.1	0.031	1.9	1.9	0.0	0.000	0.002	0.003	0.005	0.000	0.000	0.000	205	156	23	0
			(8:17 a.m. to 9:10 a.m.)	0.1	0.035	2.2	2.1	0.2	0.001	0.005	0.005	0.009	0.000	0.000	0.000	72	50	9	1
			(9:11 a.m. to 10:10 a.m.)	0.1	0.034	2.4	2.1	0.4	0.001	0.027	0.025	0.050	0.005	0.000	0.000	47	29	4	4
Whitecourt Area	11-May-01	Site # 5	(11:17 a.m. to 12:16 p.m.)	0.1	0.047	2.1	2.0	0.1	0.008	0.000	0.000	0.002	0.001	0.000	0.000	482	296	26	0
one-hour guideline				**13.0**	**0.082**	**n/a**	**n/a**	**n/a**	**0.172**	**n/a**	**0.212**	**n/a**	**2.0**	**n/a**	**0.010**	**n/a**	**n/a**	**n/a**	**n/a**

data in italics - indicates less than 75% of data available for one hour period due to interference from MAML generator exhaust or instrument malfunction

no data - indicates that the analyzer was not operational for this time period

n/a - no one hour guideline

ppm - parts per million.

ng/m^3 - nanograms per cubic metre of air.

$\mu g/m^3$ micrograms per cubic metre of air.

List of Air Quality Parameters

CO - carbon monoxide
O_3 - ozone
THC - total hydrocarbons
CH_4 - methane
RHC - reactive hydrocarbons
SO_2 - sulphur dioxide
NO_x - total oxides of nitrogen
NO_2 - nitrogen dioxide
NO - nitric oxide
NH_3 - ammonia
TRS - total reduced sulphur
H_2S - hydrogen sulphide
PAH - polycyclic aromatic hydrocarbons
TSP - total suspended particulates
PM_{10} - inhalable particulates
$PM_{2.5}$ - respirable particulates

Table A8: One-hour average air pollutant concentrations in Whitecourt/Swan Hills area survey (June 25 to 29, 2001).

Area	Date	Monitoring Location	Time (MST)	CO	O_3	THC	CH_4	RHC	SO_2	NO	NO_2	NO_X	NH_3	TRS	H_2S	TSP	PM_{10}	$PM_{2.5}$	PAH
				ppm	ppm	ppm			ppm	ppm			ppm	ppm	ppm	$\mu g/m^3$			ng/m^3
Shiningbank Lake	25-Jun-01	Site # 13	(11:17 a.m. to 12:16 p.m.)	0.2	0.023	1.7	1.8	0.0	0.000	0.001	0.001	0.002	0.000	0.000	0.000	4	2	1	0
			(12:17 p.m. to 1:17 p.m.)	0.2	0.023	1.7	1.7	0.0	0.000	0.001	0.000	0.001	0.002	0.001	0.000	4	3	1	0
Whitecourt Area	25-Jun-01	Site # 7	(3:26 p.m. to 4:24 p.m.)	0.2	0.016	2.3	2.2	0.1	0.004	0.009	0.005	0.010	0.001	0.005	0.000	17	14	3	18
		Site # 5	(4:56 p.m. to 5:56 p.m.)	0.0	0.019	2.2	2.1	0.1	0.000	0.003	0.004	0.005	0.000	0.001	0.000	7	5	1	7
Shiningbank Lake	26-Jun-01	Site # 13	(7:30 a.m. to 8:29 a.m.)	0.2	0.011	1.8	1.7	0.1	0.000	0.001	0.001	0.001	0.000	0.000	0.000	10	8	1	2
			(8:30 a.m. to 9:30 a.m.)	0.1	0.014	1.7	1.7	0.1	0.000	0.003	0.001	0.003	0.000	0.000	0.000	4	3	1	1
Whitecourt Area	26-Jun-01	Site # 6	(10:55 a.m. to 11:54 a.m.)	0.3	0.014	2.4	2.2	0.3	0.025	0.008	0.006	0.012	0.001	0.000	0.000	8	6	1	0
		Site # 5	(12:47 p.m. to 1:46 p.m.)	0.3	0.018	2.1	2.0	0.1	0.004	0.003	0.005	0.008	0.000	0.000	0.000	11	7	1	1
		Site # 6	(2:40 p.m. to 3:39 p.m.)	0.3	0.019	2.6	2.5	0.3	0.017	0.008	0.010	0.017	0.000	0.001	0.001	11	8	2	0
Whitecourt Area	27-Jun-01	Site # 1	(7:10 a.m. to 8:09 a.m.)	0.2	0.021	2.0	2.0	0.1	0.001	0.001	0.001	0.002	0.003	0.001	0.000	6	5	1	0
		Site # 2	(8:16 a.m. to 9:16 a.m.)	0.3	0.021	2.1	2.1	0.1	0.001	0.002	0.003	0.005	0.002	0.001	0.000	21	13	2	1
		Site # 3	(9:22 a.m. to 10:21 a.m.)	0.3	0.019	2.1	2.0	0.1	0.001	0.003	0.004	0.008	0.002	0.000	0.000	21	13	2	2
		Site # 4	(10:41 a.m. to 11:40 a.m.)	0.2	0.020	2.2	2.0	0.2	0.001	0.002	0.005	0.006	0.003	0.000	0.000	163	60	7	3
		Site # 1	(12:21 p.m. to 1:21 p.m.)	0.3	0.019	2.0	1.9	0.1	0.000	0.000	0.002	0.003	0.003	0.001	0.000	13	9	2	1
			(1:29 p.m. to 2:28 p.m.)	0.2	0.015	2.1	2.0	0.1	0.000	0.003	0.005	0.008	0.003	0.001	0.000	13	9	2	4
		Site # 3	(2:35 p.m. to 3:34 p.m.)	0.5	0.012	2.2	2.1	0.1	0.001	0.013	0.006	0.016	0.003	0.001	0.000	10	7	1	6
		Site # 4	(3:41 p.m. to 4:40 p.m.)	0.3	0.015	2.2	2.1	0.1	0.000	0.002	0.006	0.009	0.001	0.001	0.000	146	59	7	4
		Site # 7	(4:51 p.m. to 5:51 p.m.)	0.2	0.015	2.1	2.1	0.0	0.000	0.001	0.002	0.005	0.002	0.000	0.000	10	8	2	1
Whitecourt Area	28-Jun-01	Site # 1	(7:19 a.m. to 8:18 a.m.)	0.3	0.012	2.1	2.0	0.1	0.003	0.004	0.003	0.008	0.000	0.000	0.000	32	21	3	3
		Site # 2	(8:25 a.m. to 9:24 a.m.)	0.3	0.016	2.1	1.9	0.1	0.003	0.001	0.002	0.003	0.000	0.000	0.000	10	7	2	0
		Site # 3	(9:30 a.m. to 10:29 a.m.)	0.3	0.021	2.4	2.0	0.5	0.001	0.002	0.004	0.007	0.000	0.000	0.000	215	74	8	4
		Site # 4	(10:50 a.m. to 11:49 a.m.)	0.2	0.027	2.0	1.8	0.2	0.000	0.001	0.003	0.003	0.000	0.000	0.000	99	47	4	2
		Site # 8	(12:01 p.m. to 1:00 p.m.)	0.3	0.026	2.0	1.7	0.3	0.000	0.002	0.004	0.005	0.000	0.000	0.001	29	15	2	1
		Site # 3	(1:14 p.m. to 2:13 p.m.)	0.2	0.024	2.5	1.9	0.7	0.001	0.004	0.004	0.009	0.000	0.000	0.000	123	52	5	7
		Site # 1	(2:30 p.m. to 3:29 p.m.)	0.3	0.027	2.0	1.8	0.2	0.001	0.014	0.007	0.021	0.002	0.001	0.001	214	126	11	3
		Site # 2	(3:36 p.m. to 4:35 p.m.)	0.2	0.030	2.1	1.9	0.2	0.000	0.002	0.002	0.004	0.000	0.000	0.000	20	13	2	0
		Site # 4	(4:46 p.m. to 5:45 p.m.)	0.2	0.031	2.1	1.9	0.2	0.000	0.002	0.001	0.003	0.000	0.000	0.000	66	36	3	1
		Site # 8	(5:57 p.m. to 6:56 p.m.)	0.2	0.028	2.1	1.9	0.3	0.000	0.002	0.003	0.005	0.000	0.000	0.001	19	10	1	1
Swan Hills Area	29-Jun-01	Site # 11	(7:07 a.m. to 8:06 a.m.)	0.2	0.018	2.0	2.0	0.0	0.000	0.000	0.001	0.000	0.000	0.001	0.000	397	298	19	0
		Site # 12	(9:13 a.m. to 10:12 a.m.)	0.3	0.019	2.0	1.9	0.1	0.000	0.002	0.001	0.002	0.002	0.000	0.000	11	7	1	0
			(10:13 a.m. to 11:15 a.m.)	0.2	0.019	2.0	1.9	0.1	0.000	0.001	0.002	0.001	0.004	0.000	0.000	14	10	2	1
		Site # 11	(12:19 p.m. to 1:19 p.m.)	0.2	0.020	2.1	2.0	0.0	0.000	0.000	0.000	0.000	0.003	0.000	0.000	4	3	1	0
		Site # 9	(2:17 p.m. to 3:16 p.m.)	0.3	0.023	2.1	2.0	0.1	0.000	0.001	0.000	0.000	0.001	0.000	0.000	8	5	1	0
		Site # 10	(3:22 p.m. to 4:21 p.m.)	0.2	0.023	2.1	2.0	0.0	0.000	0.000	0.000	0.000	0.001	0.000	0.000	10	6	1	0
one-hour guideline				**13.0**	**0.082**	**n/a**	**n/a**	**n/a**	**0.172**	**n/a**	**0.212**	**n/a**	**2.0**	**n/a**	**0.010**	**n/a**	**n/a**	**n/a**	**n/a**

data in italics - indicates less than 75% of data available for one hour period due to interference from MAML generator exhaust or instrument malfunction

no data - indicates that the analyzer was not operational for this time period

n/a - no one hour guideline

ppm - parts per million.

ng/m^3 - nanograms per cubic metre of air.

$\mu g/m^3$ micrograms per cubic metre of air.

List of Air Quality Parameters

CO - carbon monoxide
O_3 - ozone
THC - total hydrocarbons
CH_4 - methane
RHC - reactive hydrocarbons
SO_2 - sulphur dioxide
NO_X - total oxides of nitrogen
NO_2 - nitrogen dioxide
NO - nitric oxide
NH_3 - ammonia
TRS - total reduced sulphur
H_2S - hydrogen sulphide
PAH - polycyclic aromatic hydrocarbons
TSP - total suspended particulates
PM_{10} - inhalable particulates
$PM_{2.5}$ - respirable particulates

Table A9: Weather Conditions and Operator's Observations in Whitecourt/Swan Hills area survey (November 20 to 24, 2000).

Area	Date	Monitoring Location	Time (MST)	Temp. °C	RH %	WSP km/h	Cloud	WDR	Operator's Observations
Shiningbank Lake	20-Nov-00	Site # 13	(11:22 a.m. to 12:22 p.m.)	-3	72	4	Clear	SW	Travel around the Shiningbank Lake area. 12:04 -12:08 pm - Readings from highway traffic.
			(12:25 p.m. to 1:30 p.m.)	1	63	7	Clear	E	
Whitecourt Area	20-Nov-00	Site # 6	(3:36 p.m. to 4:37 p.m.)	2	52	5	Clear	W	Along Windfall road ~1 km downwind of Central Alberta Midstream.
		Site # 7	(6:31 p.m. to 7:32 p.m.)	-5	85	3	Clear	W	6:32 pm-Some readings may be coming from the Highway traffic.
	21-Nov-00	Site # 1	(8:28 a.m. to 9:28 a.m.)	-7	91	4	20%	SW	37 Ave. & 35 St. (SE Industrial area).
		Site # 2	(9:40 a.m. to 10:40 a.m.)	-6	88	6	80%	W	55 Ave.& Dahl Dr. (NE residential area).
		Site # 3	(10:49 a.m. to 11:49 a.m.)	-3	81	8	60%	SW	51 St.& 55 Ave.Whitecourt Rodeo grounds.10:53 am - Stacks 1/2 km away.Slight odour like that of exhaust from a nat.gas or propane furnace.
		Site # 4	(12:07 p.m. to 1:04 p.m.)	0	68	8	20%	SW	53 Ave.& 58 St. (NW Industrial area).
		Site # 7	(1:10 p.m. to 2:10 p.m.)	2	63	4	60%	SW	1:10 pm - Entrance rd to Whitecourt Generating Stn. Strong odour of wet & rotting woodchips/shavings. O_3 readings - interference from some mill process?
		Site # 5	(2:35 p.m. to 3:36 p.m.)	4	58	9	10%	W	Downwind of Petro Can E Whitecourt plant at gate to Alliance Pipeline Compressor station.
		Site # 1	(3:52 p.m. to 4:53 p.m.)	2	66	4	10%	S	37 Ave. & 35 St. (SE Industrial area).
		Site # 2	(4:58 p.m. to 5:58 p.m.)	0	73	3	Clear	SW	55 Ave.& Dahl Dr. (NE residential).
		Site # 3	(6:15 p.m. to 7:15 p.m.)	-3	85	3	Clear-dark	S	Some dust from mill operations. PAH&RHC likely from mill operations.
		Site # 4	(7:22 p.m. to 8:22 p.m.)	-4	89	2	Clear-dark	SW	7:46 pm-High RHC levels. Odour like that of fumes when filling with gas.
Swan Hills Area	22-Nov-00	Site # 9	(8:41 a.m. to 9:48 a.m.)	-6	90	3	Clear	W	Ft Assiniboine Ranger Station.
		Site # 10	(9:58 a.m. to 10:57 a.m.)	0	77	6	Clear	W	Stop at the west edge of town at Fort Assiniboine Rodeo Grounds.
		Site # 12	(12:43 p.m. to 1:42 p.m.)	5	74	2	60%	E	Kinuso School.
			(1:43 p.m. to 2:47 p.m.)	8	63	4	60%	SW	
		Site # 11	(3:42 p.m. to 4:41 p.m.)	7	57	6	Clear	SW	Swan Hills Hospital. 4:39 pm - Some wood smoke odour in the area.
			(4:42 p.m. to 5:41 p.m.)	4	64	5	n/a	W	
Whitecourt Area	23-Nov-00	Site # 4	(8:04 a.m. to 9:04 a.m.)	-8	95	4	40%	SW	53 Ave.& 58 St. (NW Industrial area).
		Site # 3	(9:20 a.m. to 10:19 a.m.)	-4	85	4	20%	W	9:27 am-Particulates likely from operations on site.
		Site # 2	(10:31 a.m. to 11:32 a.m.)	0	73	4	n/a	W	55 Ave.& Dahl Dr. (NE residential).
		Site # 1	(11:38 a.m. to 12:37 p.m.)	4	53	5	Clear	W	37 Ave. & 35 St. (SE Industrial area).
		Site # 5	(12:50 p.m. to 1:51 p.m.)	9	36	8	Clear	SW	At gate to Alliance Pipe Compressor Stn.(Downwind of Shingbank Energy).
		Site # 4	(2:43 p.m. to 3:42 p.m.)	6	55	2	40%	S	3:23 pm-General haze in the valley area. Readings likely from many sources.
		Site # 3	(3:51 p.m. to 4:59 p.m.)	4	67	2	90%	SW	51 St. & 55 Ave. Whitecourt Rodeo grounds.
		Site # 2	(5:04 p.m. to 6:04 p.m.)	3	81	2	Dark	W	5:09 pm-Woodsmoke smell. 5:12 pm - Readings likely from traffic on Dahl dr.
		Site # 1	(6:24 p.m. to 7:24 p.m.)	1	76	3	Dark	W	37 Ave. & 35 St. (SE Industrial area).
	24-Nov-00	Site # 6	(9:17 a.m. to 10:17 a.m.)	2	47	8	Clear	W	Central Alberta Midstream.
		Site # 8	(10:45 a.m. to 11:45 a.m.)	4	53	3	Clear	S	On road 500 m E of Alberta Newsprint Co. Slight H_2S odour, from ponds?
		Site # 7	(11:59 a.m. to 12:58 p.m.)	7	41	4	Clear	S	At a gravel pit approx 2 km from plant, odour of fermenting, rotten wood chips 12:36 pm-Odour no longer present, wind has shifted.
Shiningbank Lake	24-Nov-00	Site # 13	(1:28 p.m. to 2:27 p.m.)	8	31	15	Clear	SE	Travel around the Shiningbank Lake area.
			(2:28 p.m. to 3:28 p.m.)	6	34	8	n/a	SW	Nat. gas odour near a high pressure gas pipeline.
			(3:28 p.m. to 4:28 p.m.)	5	39	3	n/a	S	Pengrowth plant. 3:59 pm-Odours, truck loading/unloading at the plant/compressor station.

* Weather conditions are based on observations at the monitoring site. Units are temperature [°C], wind speed [km/h], and cloud cover [% of sky coverage].
V - indicates the wind was from variable conditions. n/a indicates no data available.

Table A10: Weather Conditions and Operator's Observations in Whitecourt/Swan Hills area survey (February 20 to 22, and March 1 and 2, 2001).

Area	Date	Monitoring Location	Time (MST)	Temp. °C	RH %	WSP km/h	Cloud	WDR	Operator's Observations
Shiningbank Lake	20-Feb-01	Site # 13	(11:25 a.m. to 12:24 p.m.)	-8	55	3	Clear	SW	Travel around the Shiningbank Lake area.
			(12:25 p.m. to 1:24 p.m.)	-6	52	8	Clear	N	
			(1:26 p.m. to 2:25 p.m.)	-4	49	6	n/a	S	By Nova pipeline vent from Nov. survey, no odours this time, wind wrong direction. 1:48 pm-smoke haze from burning slash near SW end of Shiningbank lake. 1:56 pm-Rge Rd 145A, downwind, smoke going overhead.
Whitecourt Area	20-Feb-01	Site # 6	(4:04 p.m. to 5:03 p.m.)	-4	50	14	Clear	E	500mdownwind and SW of Central Alberta Midstream.
		Site # 5	(6:12 p.m. to 7:12 p.m.)	-6	56	3	Clear	E	~2mi east of E Whitecourt plant Shingbank Energy on Blue Ridge Rd.
Swan Hills Area	21-Feb-01	Site # 9	(9:11 a.m. to 10:13 a.m.)	-6	52	2	Clear	E	Ft. Assiniboine Ranger station.
		Site # 10	(11:46 a.m. to 12:45 p.m.)	0	31	14	Clear	E	Ft. Assiniboine rodeo grounds.
		Site # 12	(2:17 p.m. to 3:16 p.m.)	-4	44	7	Clear	W	Kinuso school.
			(3:17 p.m. to 4:17 p.m.)	-3	43	7	Clear	W	
		Site # 11	(5:49 p.m. to 6:48 p.m.)	-9	60	6	Clear	NW	Swan Hills hospital.
			(6:49 p.m. to 7:47 p.m.)	-11	66	3	Clear	SW	
Whitecourt Area	22-Feb-01	Site # 6	(9:33 a.m. to 10:32 a.m.)	-12	76	10	80%	E	On Windfall rd 400m from main stack, odours present.
		Site # 7	(11:47 a.m. to 12:47 p.m.)	-4	49	5	n/a	SE	Downwind of Whitecourt Generating Station, odour from wood chip pile.
		Site # 5	(1:10 p.m. to 2:10 p.m.)	-2	50	14	40%	E	2km Downwind of East Whitecourt plant Shingbank Energy.
Shiningbank Lake	22-Feb-01	Site # 13	(3:12 p.m. to 4:12 p.m.)	-2	48	3	n/a	NE	Travel around the Shiningbank Lake area.
			(4:13 p.m. to 5:17 p.m.)	-2	49	2	n/a	E	4:27 pm-Along Twp Rd 563, fleeting odours from vent on NOVA pipeline.
Whitecourt Area	01-Mar-01	Site # 1	(8:40 a.m. to 9:40 a.m.)	2	32	11	Clear	W	37 Ave. & 35 St. (SE Industrial area).
		Site # 2	(9:47 a.m. to 10:46 a.m.)	3	30	15	Clear	W	55 Ave.& Dahl Dr. (NE residential).
		Site # 3	(10:52 a.m. to 11:50 a.m.)	5	29	9	Clear	NW	52 St. 52 Ave at east side fenceline of Millar Western Mill.
		Site # 4	(11:57 a.m. to 12:56 p.m.)	7	24	10	Clear	W	53 Ave.& 58 St. (NW Industrial area).
		Site # 8	(1:09 p.m. to 2:08 p.m.)	7	23	9	Clear	W	Alberta Newsprint (ANC).1:10 pm-trace of TRS readings.
		Site # 7	(2:22 p.m. to 3:22 p.m.)	7	21	8	40%	SE	2:23 pm-CO likely from plant. Whitecourt Power Generating Station
		Site # 1	(3:45 p.m. to 4:45 p.m.)	7	21	3	80%	SE	37 Ave. & 35 St. (SE Industrial area).
		Site # 2	(5:10 p.m. to 6:09 p.m.)	5	27	8	100%	E	55 Ave.& Dahl Dr. (NE residential).
		Site # 3	(6:15 p.m. to 7:14 p.m.)	3	32	5	80%	E	52 St. 52 Ave at east side fenceline of Millar Western Mill
		Site # 4	(7:21 p.m. to 8:21 p.m.)	1	46	3	Dark	E	53 Ave.& 58 St. (NW Industrial area).
	02-Mar-01	Site # 1	(7:33 a.m. to 8:33 a.m.)	-3	66	3	Overcast	SE	37 ave & 35 st (SE Industrial area, Whitecourt).
		Site # 2	(8:40 a.m. to 9:40 a.m.)	-2	64	3	Overcast	E	55 Ave.& Dahl Dr. (NE residential) Lots of traffic at the 4-way stop.
		Site # 3	(9:46 a.m. to 10:46 a.m.)	0	54	3	Overcast	E	52 St.& 52 Ave at east side fenceline of Millar Western Mill.
		Site # 4	(11:07 a.m. to 12:07 p.m.)	1	49	5	Overcast	W	53 Ave.& 58 St. (NW Industrial area).
		Site # 8	(12:23 p.m. to 1:22 p.m.)	3	66	10	Overcast	NW	Alberta Newsprint (ANC).Downwind on Gravel Pit road just off plant property.
		Site # 1	(1:44 p.m. to 2:43 p.m.)	5	46	20	80%	NW	37 Ave. & 35 St. (SE Industrial area).
		Site # 2	(2:50 p.m. to 3:49 p.m.)	5	43	17	80%	N	55 Ave.& Dahl Dr. (NE residential)
		Site # 3	(3:57 p.m. to 4:55 p.m.)	5	42	10	80%	N	52 St.& 52 Ave at east side fenceline of Millar Western Mill.
		Site # 4	(5:02 p.m. to 6:01 p.m.)	5	39	8	80%	V	53 Ave.& 58 St. (NW Industrial area).

* Weather conditions are based on observations at the monitoring site. Units are temperature [°C], wind speed [km/h], and cloud cover [% of sky coverage].
V - indicates the wind was from variable conditions. n/a indicates no data available.

Table A11: Weather Conditions and Operator's Observations in Whitecourt/Swan Hills area survey (May 7 to 11, 2001).

Area	Date	Monitoring Location	Time (MST)	Temp. °C	RH %	WSP km/h	Cloud	WDR	Operator's Observations
Shiningbank Lake	07-May-01	Site # 13	(1:28 p.m. to 2:27 p.m.)	16	20	n/a	40%	n/a	Shiningbank Lake area.
			(3:00 p.m. to 4:00 p.m.)	19	20	8	20%	W	Sunny, 3:03 pm-Slight natural gas type odour approx 200m N of Twp Rd.
Whitecourt Area	07-May-01	Site # 5	(5:23 p.m. to 6:25 p.m.)	20	18	7	10%	N	East Whitecourt plant Shingbank Energy (formerly Petro Canada).
	08-May-01	Site # 1	(7:08 a.m. to 8:08 a.m.)	10	48	10	Clear	W	37 Ave. & 35 St. (SE Industrial area).
		Site # 2	(8:17 a.m. to 9:20 a.m.)	13	48	19	10%	NW	55 Ave.& Dahl Dr. (NE residential).
		Site # 3	(9:26 a.m. to 10:26 a.m.)	13	46	16	10%	W	52 St. 52 Ave at east side fenceline of Millar Western Mill.
			(10:26 a.m. to 11:26 a.m.)	11	57	19	60%	NW	
		Site # 4	(11:41 a.m. to 12:39 p.m.)	10	55	14	10%	NW	53 Ave.& 58 St. (NW Industrial area). Spitting rain.
		Site # 8	(2:00 p.m. to 3:00 p.m.)	12	46	9	80%	W	Alberta Newsprint (ANC).
		Site # 4	(3:20 p.m. to 4:20 p.m.)	14	30	13	80%	NW	53 Ave.& 58 St. (NW Industrial area).
		Site # 7	(4:27 p.m. to 5:26 p.m.)	14	20	17	80%	NW	4:30 pm-Elevated RHC's are from Whitecourt Power Generating Station.
		Site # 2	(5:50 p.m. to 6:50 p.m.)	13	18	17	10%	NW	55 Ave.& Dahl Dr. (NE residential).
		Site # 1	(7:00 p.m. to 8:00 p.m.)	11	21	14	10%	NW	37 Ave. & 35 St. (SE Industrial area).
Swan Hills Area	09-May-01	Site # 9	(8:03 a.m. to 9:03 a.m.)	10	29	8	Clear	W	Fort Assiniboine Ranger Station.
		Site # 10	(9:14 a.m. to 10:12 a.m.)	11	24	23	Clear	NW	Fort Assiniboine Rodeo Grounds.
		Site # 12	(12:07 p.m. to 1:06 p.m.)	11	28	11	40%	W	Kinuso School.
			(1:07 p.m. to 2:07 p.m.)	11	26	10	n/a	W	
		Site # 11	(3:05 p.m. to 4:04 p.m.)	8	22	17	80%	W	Swan Hills Hospital.
			(4:04 p.m. to 5:04 p.m.)	8	22	15	n/a	W	
Whitecourt Area	10-May-01	Site # 1	(7:03 a.m. to 8:03 a.m.)	5	39	5	Clear	W	37 Ave. & 35 St. (SE Industrial area).
		Site # 2	(8:09 a.m. to 9:09 a.m.)	8	33	6	Clear	NW	55 Ave.& Dahl Dr. (NE residential).
		Site # 3	(9:20 a.m. to 10:20 a.m.)	11	24	11	Clear	W	Slight resin type odour mixed with sawn lumber odour from mill operations.
		Site # 4	(10:43 a.m. to 11:43 a.m.)	13	21	11	40%	W	53 Ave.& 58 St. (NW Industrial area).
		Site # 8	(11:55 a.m. to 12:55 p.m.)	14	19	8	60%	SW	~600m from mill site at gravel pit. Slight odour of sawdust apparent.
		Site # 7	(1:23 p.m. to 2:23 p.m.)	15	19	9	80%	W	Odour of rotting wood chips, a little like fermenting wine.
		Site # 4	(2:28 p.m. to 3:28 p.m.)	14	19	9	60%	W	53 Ave.& 58 St. (NW Industrial area).
		Site # 3	(3:33 p.m. to 4:32 p.m.)	14	22	8	80%	S	Odour of sawn wood. 51 St. & 55 Ave. (Whitecourt Rodeo grounds).
		Site # 2	(4:41 p.m. to 5:40 p.m.)	15	20	9	80%	W	Light evening traffic in the area. 55 Ave.& Dahl Dr. (NE residential)
		Site # 1	(5:46 p.m. to 6:45 p.m.)	13	23	9	60%	W	37 Ave. & 35 St. (SE Industrial area).
Shiningbank Lake	11-May-01	Site # 13	(7:16 a.m. to 8:16 a.m.)	7	57	6	100%	S	Shiningbank Lake area. High thin cloud.
			(8:17 a.m. to 9:10 a.m.)	10	47	5	n/a	S	Shiningbank Lake area.
			(9:11 a.m. to 10:10 a.m.)	12	36	8	n/a	SE	
Whitecourt Area	11-May-01	Site # 5	(11:17 a.m. to 12:16 p.m.)	16	24	9	n/a	W	East Whitecourt plant Shingbank Energy (formerly Petro Canada).

* Weather conditions are based on observations at the monitoring site. Units are temperature [°C], wind speed [km/h], and cloud cover [% of sky coverage].
V - indicates the wind was from variable conditions. n/a indicates no data available.

Table A12: Weather Conditions and Operator's Observations in Whitecourt/Swan Hills area survey (June 25 to 29, 2001).

Area	Date	Monitoring Location	Time (MST)	Temp. °C	RH %	WSP km/h	Cloud	WDR	Operator's Observations
Shiningbank Lake	25-Jun-01	Site # 13	(11:17 a.m. to 12:16 p.m.)	11	86	n/a	Overcast	n/a	Light rain. 11:40 am-Smell of woodsmoke but none visible.
			(12:17 p.m. to 1:17 p.m.)	12	80	10	80%	NE	Sunny, 12:29 pm-Stop, pick up odour from ATCO gas HP pipeline.
Whitecourt Area	25-Jun-01	Site # 7	(3:26 p.m. to 4:24 p.m.)	10	100	4	Overcast	NW	3:38 pm-Raining hard. Whitecourt Power Generating Station.
		Site # 5	(4:56 p.m. to 5:56 p.m.)	14	92	4	Overcast	NW	Rain, some gas plant odour. East Whitecourt plant Shingbank Energy.
Shiningbank Lake	26-Jun-01	Site # 13	(7:30 a.m. to 8:29 a.m.)	9	100	n/a	Overcast	n/a	Shiningbank Lake area. Fog, light sprinkle of rain.
			(8:30 a.m. to 9:30 a.m.)	11	93	n/a	Overcast	n/a	8:47 am-No odours from Atco Gas HP pipeline vent. 8:58 am-fog has lifted.
Whitecourt Area	26-Jun-01	Site # 6	(10:55 a.m. to 11:54 a.m.)	11	94	9	Overcast	NE	Stop 1km downwind of BP Amoco West Whitecourt (Windfall) and Husky Sulphur pads. Light rain. Plant is in full operation after turnaround in May.
		Site # 5	(12:47 p.m. to 1:46 p.m.)	13	85	9	Overcast	E	Approx. 1.5 km downwind of East Whitecourt plant Shingbank Energy.
		Site # 6	(2:40 p.m. to 3:39 p.m.)	12	84	8	Overcast	N	1km downwind of BP W Whitecourt plant & Husky sulphur pads. Sulphur odours.
	27-Jun-01	Site # 1	(7:10 a.m. to 8:09 a.m.)	11	91	10	Overcast	E	37 Ave. & 35 St. (SE Industrial area).
		Site # 2	(8:16 a.m. to 9:16 a.m.)	11	89	13	Overcast	E	55 Ave.& Dahl Dr. (NE residential).
		Site # 3	(9:22 a.m. to 10:21 a.m.)	12	86	5	Overcast	E	52 St. 52 Ave at east side fenceline of Millar Western Mill.
		Site # 4	(10:41 a.m. to 11:40 a.m.)	12	86	6	Overcast	E	53 Ave.& 58 St. (NW Industrial area).
		Site # 1	(12:21 p.m. to 1:21 p.m.)	12	90	9	Overcast	E	37 Ave. & 35 St. (SE Industrial area). Light sprinkle of rain.
			(1:29 p.m. to 2:28 p.m.)	13	92	8	Overcast	E	37 Ave. & 35 St. (SE Industrial area). Light rain.
		Site # 3	(2:35 p.m. to 3:34 p.m.)	13	90	4	Overcast	E	52 St.& 52 Ave at E side fenceline of Millar Western Mill. Light rain.
		Site # 4	(3:41 p.m. to 4:40 p.m.)	13	92	5	Overcast	SE	53 Ave.& 58 St. (NW Industrial area). Light rain.
		Site # 7	(4:51 p.m. to 5:51 p.m.)	13	94	8	Overcast	E	Whitecourt Power Generating Station. Light rain.
	28-Jun-01	Site # 1	(7:19 a.m. to 8:18 a.m.)	14	82	12	Overcast	W	37 Ave. & 35 St. (SE Industrial area).
		Site # 2	(8:25 a.m. to 9:24 a.m.)	17	71	14	60%	NW	55 Ave.& Dahl Dr. (NE residential).
		Site # 3	(9:30 a.m. to 10:29 a.m.)	18	65	12	80%	W	Sawdust & wood smell. Downwind of plumes from Millar Western pulp mill.
		Site # 4	(10:50 a.m. to 11:49 a.m.)	21	54	11	60%	W	53 Ave.& 58 St. (NW Industrial area).
		Site # 8	(12:01 p.m. to 1:00 p.m.)	20	55	8	40%	SW	Alberta Newsprint (ANC). Sawdust odour.
		Site # 3	(1:14 p.m. to 2:13 p.m.)	20	54	17	60%	N	Sawdust and wood smell. Downwind of plumes from Millar Western pulp mill.
		Site # 1	(2:30 p.m. to 3:29 p.m.)	22	45	15	40%	NW	37 Ave. & 35 St. (SE Industrial area).
		Site # 2	(3:36 p.m. to 4:35 p.m.)	21	49	13	40%	W	55 Ave.& Dahl Dr. (NE residential)
		Site # 4	(4:46 p.m. to 5:45 p.m.)	20	51	11	40%	NW	53 Ave.& 58 St. (NW Industrial area).
		Site # 8	(5:57 p.m. to 6:56 p.m.)	20	54	8	20%	N	Alberta Newsprint (ANC). Sawdust odour.
Swan Hills Area	29-Jun-01	Site # 11	(7:07 a.m. to 8:06 a.m.)	7	100	8	Overcast	W	Swan Hills Hospital. Light rain.
		Site # 12	(9:13 a.m. to 10:12 a.m.)	17	67	4	90%	SW	Kinuso School.
			(10:13 a.m. to 11:15 a.m.)	18	64	5	80%	S	Kinuso School.
		Site # 11	(12:19 p.m. to 1:19 p.m.)	11	89	6	Overcast	V	Swan Hills Hospital. Raining.
		Site # 9	(2:17 p.m. to 3:16 p.m.)	18	54	4	Overcast	V	Fort Assiniboine Ranger Station.
		Site # 10	(3:22 p.m. to 4:21 p.m.)	17	64	8	Overcast	E	Fort Assiniboine Rodeo Grounds.

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V - indicates the wind was from variable conditions. n/a indicates no data available.